PART I

OVERVIEW

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Chapter 1 Introduction

1 - 1 Objectives of the Survey

In response to the request from the Government of the Republic of Indonesia to conduct mineral exploration, the Japanese Government sent a mission for Scope of Work Consultation to Indonesia in September 2001. And as a result of consultation with the Directorate General of Geology and Mineral Resources of Indonesia, an agreement was reached for cooperative mineral exploration of the East Java area and the Scope of Work was concluded by representative of both Governments in 19 September 2001. The objective of this project is to assess the mineral potential of the area through analysis of existing data, analysis of satellite images, geological survey, geochemical survey, geophysical exploration, and drilling during the three year period from fiscal 2001 to 2003. The counterpart organization in accordance with this Scope of Work is the Directorate of Mineral Resources Inventory.

During the second year of the project, regional geochemical and semi-detailed geochemical surveys and geological survey were carried out over an area of 3, 6000km^2, 800km^2 and 70 km^2, respectively. The fieldwork of geochemical survey was done from 26 August 2002 to 13 November 2002. The fieldwork of geological survey was done from 26 January 2002 to 28 February 2003.

1 - 2 Survey Methods

(1) Outline of the survey

The survey of the second year of the project consisted of regional and semi-detailed geochemical surveys, and geochemical surveys. Regarding the examination of existing data, available information concerning geology and mineral deposits of the previous concessions southeast of Ponorogo area were studied, summarized and guidelines and plans for field survey were prepared.

Regional geochemical survey were carried out in the field. Of the 3, 600km^2 survey area delineated for geological investigation, for traversing and geological survey covered an area of 60km^2 and total length of the survey route amounted to 100km. Soils for geochemical analysis were also sampled simultaneously with the geological survey. The stream sediments samples were sent to ALS

Chemex Laboratory in Canada, after or without drying depending on the sampling methods.

(2) Work carried out

The total work carried out in the field and in the laboratories is laid out in Tables 1-1.

Table 1-1(a) Amount of Work: Field Work

Work	Amount
Existing Data Compilation	Area: 800km^2
Regional Geochemical Survey	Area: 3,600km^2
Semi-detailed Geochemical Surveys	Area: 800km^2
Geological Surveys	Traverse Area: 70km^2 Total Length of Route: 100 km

Table 1-1(b) Amount of Work: Laboratory: Tests Carried Out

	Work Items	Amount
Regional Geochemical Surveys	Observation of thin section of rock samples	50 samples
	Observation of polished section of ore samples	50 samples
	Powder X-ray diffraction analysis	50 samples
	Chemical analyses of rock and ore samples (Elements: Au, Ag, Cu, Pb, Zn, As, Hg, Sb)	100 samples
	Chemical analyses of stream sediments (49 Elements: Au, Al, Ag, As, Ba, Be, Bi, Ca, Cd, Cr, Co, Cs, Cu, Fe, Ga, Ge, Hf, Hg, In, K, La, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Rb, Re, S, Sb, Sc, Se, Sn, Sr, Ta, Te, Th, Ti, Tl, U, V, W, Y, Zn, Zr)	1,660 samples
	Fluid inclusion measurement (Homogenization temperature and salinity)	5 samples
	Whole rock chemical analysis	20 samples
	Age determination(K-Ar Method)	10 samples
Semi-detailed Geochemical	Observation of thin section of rock samples	3samples
	Observation of polished section of ore samples	33 samples
	Powder X-ray diffraction analysis (Elements: Au, Ag, Cu, Pb, Zn, As, Hg, Sb)	32 samples

Surveys	Chemical analyses of stream sediments (49 Elements: Au, Al, Ag, As, Ba, Be, Bi, Ca, Cd, Cr, Co, Cs, Cu, Fe, Ga, Ge, Hf, Hg, In, K, La, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Rb, Re, S, Sb, Sc, Se, Sn, Sr, Ta, Te, Th, Ti, Tl, U, V, W, Y, Zn, Zr) Fluid inclusion measurement (Homogenization temperature and salinity)	497 samples 24 samples
Geological Surveys	Observation of thin section of rock samples Observation of polished section of ore samples Powder X-ray diffraction analysis Chemical analyses of rock and ore samples (Elements: Au, Ag, Cu, Pb, Zn, As, Hg, Sb) Chemical analyses of soil sediments (49 Elements: Au, Al, Ag, As, Ba, Be, Bi, Ca, Cd, Cr, Co, Cs, Cu, Fe, Ga, Ge, Hf, Hg, In, K, La, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Rb, Re, S, Sb, Sc, Se, Sn, Sr, Ta, Te, Th, Ti, Tl, U, V, W, Y, Zn, Zr) Fluid inclusion measurement (Homogenization temperature and salinity) Whole rock chemical analysis	50 samples 50 samples 100 samples 250 samples 200 samples 5 samples 20 samples

1 - 3 Members of the Survey Team

(1) Regional Geochemical Survey

Regarding the second year regional geochemical survey of this project, field work was carried out from 26 August 2002, to 13 November of the same year. Six scientists from Japan and seven scientists from Indonesia formed the field survey team. Also the Indonesian Project Leader Mr. Bambang Pardiarto participated in the fieldwork from 28 to 29 September.

[Indonesian Side: Directorate of Mineral Resources Inventory]

Widodo Wahyu.	(Team leader, geochemical survey)
Hotma Simangunsong	(Geochemical survey)
Sahat Simanjuntak	(Geochemical survey)
Zulkifuli, MD	(Geochemical survey)
Iwan Nursahan	(Geochemical survey)

Rachmat Effendi	(Geochemical survey)

[Japanese Side]

Osamu Miyaishi	(Team leader, geochemical survey)
Tetsuo Sato	(Geochemical survey)
Koji Hamano	(Geochemical survey)
Tadanori Iwasaki	(Geochemical survey)
Ken Obara	(Geochemical survey)
Masahiro Suzuki	(Geochemical survey)

(2) Semi-detailed survey team

[Indonesian Counterpart Organization: Directorate of Mineral Resources Inventory]

Atok S. Prapto.	(Team leader, geochemical survey)
Bambang Nuguroho Widi	(Geochemical survey)
Sukumana	(Geochemical survey)

[Japanese Side]

Tetsuo Suzuki	(Team leader, geochemical survey)
Koji Yamamoto	(Geochemical survey)
Kazuhiro Miyake	(Geochemical survey)

(3) Geological Survey

[Indonesian Counterpart Organization: Directorate of Mineral Resources Inventory]

Widodo Wahyu.	(Team leader, geological survey)
Hotma Simangunsong	(Geological survey)
Sahat Simanjuntak	(Geological survey)
Atok S. Prapto	(Geological survey)
Sukumana	(Geological survey)
Iwan Nursahan	(Geological survey)
Rachmat Effendi	(Geological survey)

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Osamu Miyaishi	(Team leader, geological surveys)
Susumu Takeda	(Geological surveys)
Tetsuo Sato	(Geological surveys)

Koji Hamano (Geological surveys)
Tadanori Iwasaki (Geological surveys)
Ken Obara (Geological surveys)

[Field Survey Supervision]
Koji Yamamoto (Global Minerals Exploration Group, Mineral Resources Survey Department, MMAJ)

1 - 4 Duration of Survey

The duration of survey was from 24 July 2002 to 14 March 2003 and that of the fieldwork of regional geochemical survey, semi-detailed survey and geological survey were from 26 August to 13 November, 2002, 26 August to 13 October, 2002 and from 26 January to 28 February, 2003, respectively.

Chapter 2　Geography of the Survey Area

2 - 1　Survey area

Regional and semi-detailed geochemical surveys were carried out over an area of 3, 600km^2 and 800km^2, respectively. The eastern part of regional geochemical survey area is called the East area and western part of the regional geochemical survey area is called the West area. Geological survey was conducted in two districted that were delineated by the phase two geochemical surveys within the 19,000km^2 (project area): Ponorogo South district, and Prambon district.

Table 1-2　Coordinates of Project and Survey Areas

		Latitude(S)	Longitude(E)		Latitude(S)	Longitude(E)
Project Area	(a)	7° 43.5 ′	110° 30 ′	(b)	7° 45.0 ′	113° 15.00 ′
	(c)	8° 25.18 ′	110° 30 ′	(d)	8° 25.18 ′	113° 15.00 ′
Survey Area(E)	(a)	7° 43.50 ′	111° 38.57 ′	(b)	7° 45.0 ′	113° 15.00 ′
	(c)	8° 21.25 ′	111° 38.57 ′	(d)	8° 25.18 ′	113° 15.00 ′
Survey Area(W)	(a)	7° 43.5 ′	110° 30 ′	(b)	7° 43.5 ′	110° 52.79 ′
	(c)	8° 25.18 ′	110° 30 ′	(d)	8° 21.25 ′	110° 52.79 ′
Detailed Geochemical Survey Area	(a)	7° 43.5 ′	110° 30 ′	(b)	7° 43.5 ′	110° 52.79 ′
	(c)	8° 25.18 ′	110° 30 ′	(d)	8° 21.25 ′	110° 52.79 ′
Geological Survey Area (Ponorogo South)	(a)	7° 43.5 ′	110° 30 ′	(b)	7° 43.5 ′	110° 52.79 ′
	(c)	8° 25.18 ′	110° 30 ′	(d)	8° 21.25 ′	110° 52.79 ′
Geological Survey Area (Prambon district)	(a)	7° 43.5 ′	110° 30 ′	(b)	7° 43.5 ′	110° 52.79 ′
	(c)	8° 25.18 ′	110° 30 ′	(d)	8° 21.25 ′	110° 52.79 ′

Note: (a) to (d) show the corners of the project and survey areas

2 - 2 Topography and Drainage

Access: Regular airline was used for trips between Jakarta and Yogyakarta and from Surabaya to Bandung. Survey equipment was sent for a distance of about 4,000 km from Bandung to Yogyakarta by vehicles taking 10 to 13 hours. Base camps were set up in the following towns or cities.

(1) Regional geochemical survey base camps: Klaten, Wonogiri, Tulungagung, Blitar, Malang and Lumajang.

(2) Semi-detailed geochemical survey base camps: Ponorogo, Pacitan, Pakisbaru.

(3) Geological survey base camp: Ponorogo

Of the roads in the survey area, the major highways joining Wonogiri, Ponorogo, Pacitan, Tulungagung, Blitar, Malang and Lumajang are paved and relatively well maintained. Other roads within the area are narrow and bumpy, but are developed rather densely.

Topography: Many volcanoes with elevation exceeding 2, 000 m occur in the east to west direction in somewhat southern part of Java Island, and Mt. Semeru in the eastern part of the project area towers 3, 676m high. Relatively gently undulating hilly areas exist between these volcanoes. The survey area to the south of this row of volcanoes consists of steep mountainous terrain, but the topography to the east and west of the survey area is relatively flat with gentle relief. The area to the east has limestone karst topography. The area to the north of the volcanic row generally has lower elevation compared to the south, and thus the drainage divide is located southward and the larger rivers drain northward. The major rivers are Brantas River, and Solo River.

2 - 3 Climate and Vegetation

Climate: Eastern Java is located in the tropical rain forest climate zone, and it is divided into the dry (May – October) and wet (November – April) seasons. The average precipitation is 2, 000 ~ 2, 500mm and the average monthly temperature ranges between 23 to 32°C (Pacitan). The temperature and precipitation of Malang in the eastern part of the survey area is shown in the table below. The regional semi-detailed geochemical surveys were carried out during the dry season, and clear sky with scant rainfalls continued. The geological survey was carried out in the wet seasons and it rained almost everyday during the 19 days in the field work, and the water sometimes rose in rivers.

Table 1-3 Temperature and Precipitation in the Project Area

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Temperature (℃)	25	25	25	25	26	25	24	24	25	25	25	25
Monthly Precipitation (mm)	249	272	237	140	59	32	20	28	28	75	164	282

Vegetation: With the exceptions of the parts in the south, the area is cultivated close to the mountain summits and rice fields and farms are developed extensively. There are not many jungles, and the vegetation is generally sparse. Eggplants, pepper, banana, papaya, pineapples, as well as crops such as rice, corn, and casaba are cultivated in the field.

2 - 4 Administrative Districts

As mentioned earlier, the project area extends over 19, 000km^2 in the eastern part of Java Island, and administratively it spreads across East Java Province, Central Java Province, and Yogyakarta Special District. The eastern part of the area for the regional geochemical surveys belongs to the East Java Province, and the western part to the Central Java Province and the East Java Province. Kabupaten (Regency) Ponorogo, Kabupaten Trenggalek, Kabupaten Madiun, Kabupaten Magetan, Kabupaten Tulungagung, Kabupaten Blitar, Kabupaten Malang and Kabupaten Lumajang belong to the East Java Province and Kabupaten Klaten, Kabupaten Sukoharjo and Kabupaten Wonogiri are in the Central Java Province.

Chapter 3 Geology of Project Area

3 - 1 General Geology of the Vicinity of the Project Area

The project area is located in an island arc related to the present subduction of the Australia-India Plate under the Eurasia Plate, and a row of volcanoes occurs in the east-west direction. This volcanic arc overlaps the Tertiary volcanic arc and largely controls the geology and geologic structure of the survey area. East Java is divided into 4 zones, namely from the north southward, Rembang Zone, Kendeng Zone, Central Volcanic Zone, and Southern Mountain Zone. The Rembang and Kendeng Zones consist mainly of post-Oligocene sandstone-mudstone and limestone with intercalation of volcaniclastic rocks. The Central Volcanic Zone is composed mainly of post-Pliocene volcanic rocks. In the Southern Mountain Zone, pre-Tertiary metamorphic rocks are exposed at some places, and these are overlain by widely occurring Eocene and Oligocene to Pliocene volcanic rocks and limestone units.

The project area spreads across the two southern zones, namely the Central Volcanic and Southern Mountain Zones.

The geology of the survey area is comprised mainly of Eocene to Pleistocene volcanic and volcaniclastic rocks, and Oligocene-Miocene to Pliocene limestone occurs in the northwestern to central southern parts. Also the intrusive bodies consist of basalt, andesite, dacite and diorite.

Table 1-4 Simplified Stratigraphy of East Java

Age	Rembang Zone	Kendeng Zone	Central Volcanic Zone	Southern Mountain Zone
Pleistocene	Alluvium Limestone	Alluvium Limestone	Volcanics Alluvium Limestone	Alluvium, Limestone
Pliocene	Limestone	Limestone Conglomerate, sandstone Volcaniclastics	Volcanics Sandstone, Marl	Volcanics
Late Miocene	Sandstone, Marl	Sandstone Marl Volcanics		Volcanics Limestone
Early - Late Miocene	Claystone, Marl Limestone	Sandstone Mudstone		Volcanics Limestone
Late Oligocene -Early Miocene				Volcanics Limestone
Eocene				Sandstone, Siltstone Limestone
Pre-Tertiary				Schist Limestone

3 - 2 Geology of the Survey Area (Outline of Previous Surveys)

The geology of survey area consists of Tertiary and Quaternary System with basement composed of pre-Tertiary metamorphic rocks mentioned above. The oldest exposed formation in this area is Oligocene volcanic and volcaniclastic rocks, and sedimentary rocks. They are called Mandalika Formation and Arjosari Formation respectively. Miocene to Pliocene Series occur widely and they are; Wuni and Semilir Formations consisting mainly of volcanic and volcaniclastic rocks, Campurdarat and Wonosari Formations composed mainly of limestone, and Nampol, Jaten, and Oyo Formations consisting mainly of sedimentary units. Also basalt, andesite, and diorite intrusive bodies are exposed. The Quaternary System occurs in the northern part of the area, and it consists of Pleistocene to Holocene volcanic, volcaniclastic rocks and unconsolidated sediments. NW-SE and NE-SW trending faults are predominant in this area.

(a) Stratigraphy

The lowermost units exposed in this area are Arjosari Formation-Dayakan Formation consisting mainly of volcanic and volcaniclastic rocks, and Mandalika Formation, Watupatok Formation, Panggang Formation composed of conglomerate and sandstone. These units are correlated to Oligocene and Miocene Series. The overlying Miocene Series are composed of Nglanggran Formation, Semilir Formation, Wuni Formation consisting of volcanic rocks and volcaniclastic rocks and Sampung Formation, Jaten Formation, Oyo Formation consisting mostly of conglomerate, sandstone, mudstone and marl, and Campurdarat Formation and Wonosari Formation consisting of limestone.

The igneous activity of the survey area is predominantly andesitic and basaltic, and judging from Oligocene (?) welded tuff in the eastern part, it is believed to have begun as dacitic terrigenous volcanic activities. The distribution of the dacitic welded tuff indicate bimodal activity from Oligocene to Miocene. The stratigraphic division and correlation of the volcanic rocks of the survey area is difficult, and defining lithofacies division for each lithologic distribution area, as was done in the existing geological maps, is believed to be appropriate. Also dolerite, diorite, and porphyry intrusive bodies are exposed in this area. The Quaternary System is widely developed in the northern part and it consists of Pleistocene to Holocene volcanic and volcaniclastic rocks.

(b) Geologic structure

The Tertiary System largely show E-W to ENE-WSW strike with less than 30° dip. Occurrence of gentle and short wavelength fold structure with axes extending in the E-W to ENE-WSW direction is inferred. On the other hand, lower formations appear to be distributed in the northeastern part and the upper units in the southwestern part, and further study is warranted.

Large-scale lateral faults with NE-SW trend are interpreted to run at the lower elevation areas near Wonogiri, Tulungagung and Malang. They appear to be young structures and control the geologic structure of the area. The older faults trend NE-SW and NW-SE directions. In the West Area, faults with the NW-SE trends often dislocate the faults of NE-SW trends. Also in the East Area, faults trend NE-SW and NW-SE directions occur. Many mineralized zones are associated with N-S to NW-SE trending short and small faults and fissures. For example, quartz veins with N-S strike occur in the Selogiri area. Also many smaller NE-SW and NW-SE fault systems occur in the area.

3 - 3 Outline of the Mineral Showings in the Survey Area

Gold, silver, copper, lead, zinc mineralization is known in this area. Most of them are believed to be of hydrothermal origin, but the possibility of blind porphyry copper deposits should be considered. Also clay deposits associated with volcanic activities and limestone deposits are the main non-metallic deposits.

(1) Regional Geochemical Survey Area

Mineralization near the Selogiri gold deposits is the well known gold prospect. The Selogiri area was active and visited briefly during the Phase I Survey. Quartz veinlets occur in the area. The width of each vein varies from 5 cm to 40 cm, and total length of the veining zones extends more than 500 m. A sample from the underground workings shows 2.0g/tAu. Wide area of the Penyelidikan area is investigated by DMR. Mercury mineralization is shown on the existing geologic map the Wonosari-Klaten area. Several manganese prospects are known in the survey area.

In the East Area, there are several prospects conducted in Tulungagung, Blitar and Lumajang by Timah Investasi Mineral. Aneka Tambang holds concessions in the Sooko area east of Ponorogo. Precious metal mineralization area in silicified rocks to south of Trenggalek is hold by Fajar Minerals. Other precious mineralization area to south of Blitar is hold by Royal Indo Tama. Gold occurrences in the Kali Jinggring and Gunung Klitik areas are investigated by Timah Investasi Mineral. Hydrothermal alteration area near Tempursari is also investigated by the company.

(2) Semi-detailed Geochemical Area

Gold, silver, copper, lead, zinc, and iron-manganese prospects are known in the survey area. Gold deposits associated with quartz veins are widely distributed from Ponorogo to Pacitan. Several areas are investigated by this Phase I survey. Seven holes with a total length of 1, 005m were drilled jointly by DMR and the Korea Mining Promotion Corporation at Kasihan about 20km north of Pacitan in 1993, and weak copper, lead, zinc mineralization was identified. Their route maps show occurrence of hedenbergite and magnetite and lead and copper oxides and existence of skarn-type ore deposits is a possibility.

Table 1-5 Mineral Showings in the Regional Geochemical Survey Area

Mineral occurrences	Location	Mining Right	Geology & Mineralization	Previous Work
1. Selogiri	Wonogiri	Kud Akur	Quartz vein in Mandalika F.	Small scale mining
2. Hg occurrence (?)	Klaten	—	Pre-Tertiary Schist	Survey by DMR
7. Penyelidikan	Klaten, Yogyakarta	—	Mandalika F.	Geochemical Survey by DMR
3. Sooko	Ponorogo	Aneka Tambang (as of 8,2002）	Quartz , silicified vein in Mandalika F.	Survey by Aneka Tambang
4. Sentul	Trenggalek	Fajar Mineral International	Silicification in Mandalika F.	Drilling by Aneka Tambang
5. K.Jinggring	Tulungagung	—	Quartz vein in Mandalika F.	Geochemical Survey by Timah Investasi Mineral (9ppbAu)
6. Blitar	Blitar	Royal Indotama	Mandalika F.	Geochemical Survey by Timah Investasi Mineral
7. G.Klitik	Blitar	Timah Investasi Mineral	Mandalika F.	Geochemical Survey
8. Tempursari	Lumajang	Timah Investasi Mineral	Mandalika F.	Survey by Australian Co. in around 2000 鉱。

Chapter 4 Analyses of Survey Results

4 - 1 Mineralization Characteristics and Structural Control

(1) Tectonics and distribution of ore deposits

The project area belongs to the subduction zone of the Indian-Australia Plate at Sunda Trench, and it is inferred that Sunda-Banda Arc extending westward from Sumatra through Java and Sumbawa is under similar geologic environment. In this area, Gunung Pongkor gold and silver mine in West Java Province and Batu Hijau porphyry gold and copper mine in Sumbawa Island are operating near the survey area.

The gold-silver deposit of the Gunung Pongkor mine occurs in Tertiary volcanic and volcaniclastic rocks, and the structure of the area is characterized by faults of NW-SE to WNW-ESE system and fold axis extending in the E-W direction. The extension of the major 4 veins is 300~1,000m in the strike direction, the confirmed extension in the dip direction is less than 300m and average vein width is 2.5~8.0m. The gangue minerals are mainly quartz and adularia and ore minerals are native gold and argentite. Silicification and argillization (sericite, smectite) are observed near the deposit. The Ag/Au ratio of the ore ranges from 1.5 to 30 (average 9) and the heavy metal and As content is generally low at less than 100ppm. The age of mineralization is considered to be 8~9Ma or younger.

The Batu Hijau porphyry gold and copper deposit is located at the southwestern part of the Sumbawa Island of the Sunda-Banda Arc. Host rocks are Early Tertiary andesite lava・volcaniclastics and quartz diorite・tonalite. Mineralization and alteration are divided into three stages. The major ore minerals are chalcopyrite and bornite in quartz veinlets, and identified alteration minerals are biotite, magnetite, sericite, albite, smectite, kaolin and others. The mineralization and alteration are more than 1km wide, they pinch and swell and extend for several kilometers, and their depth extends for 1,000m.

The above two deposits were both formed under regional geologic environment of Tertiary island arc characterized by NW-SE, ENE-WSW system faults, E-W trending folds, occurrence of andesite of calc-alkali rock series, and other relevant features similar to East Java, the project area for the present geological and geochemical surveys.

(2) Mineralization in the geochemical survey area

Gold, silver, copper, lead, and zinc mineralization is observed in the second-year area for geochemical regional survey. Also manganese mineralization was observed, but it was of smaller scale. The gold, silver, copper, lead, and zinc mineralization was mainly found in chalcopyrite-galena-sphalerite-bearing quartz veins. Skarn minerals occur in existing mining concession area and associated base-metal mineralization is inferred to occur. Results of geochemical survey showed geochemical anomalies of gold, silver, copper, lead, and zinc.

Major mineralized zones of the survey area are concluded to occur at the following districts.

(a) Selogiri district: Selogiri deposit in the eastern margin of the western area and auriferous quartz veins in the vicinity.

(b) Prambon district: Quartz veins (gold, silver anomalies) to the north of Trenggalek in the southwestern part of the eastern area of the district.

(c) Sentul East district: Silicified zones to the southwest of Trenggalek.

(d) Seweden district: Alteration zones associated with gold, copper mineralization to the south of Blitar in the central part of eastern area of the district.

(e) Purwodadi district: Copper, gold mineralized and altered zones to the southeast of Malang.

(f) Tempursari district: Gold, copper mineralized and altered zones.

(g) K. Jinggring district: Gold anomalous zones to the south of Tulungagung in the western part of the eastern area.

(h) Seweden East district：Geochemical anomalies, quartz veinlets, alteration zones near the Royal Indotama concession

(i) Purwoharjo district: Copper anomaly zone continuing northeastward from this district.

(3) Geologic horizon of the host rocks and mineralization

The geology of the survey area consists mainly of Oligocene to Miocene volcanic rocks and Pliocene limestone, and Quaternary volcanic rocks occur in the northern part. The volcanic rocks mostly belong to Mandalika Formation, and the major units consist of basaltic, andesitic, and dacitic lava and volcaniclastic rocks and they are mostly coarse-grained. In the western part, tuff and tuffaceous sandstone of the Semilir and Nglanggran Formations show bedded structure. The volcanic rocks in the eastern part are those of calc-alkali rock series, but both tholeiite series and calc-alkali series occur in the western part of the area.

The mineralized geologic units are mostly Oligocene to Miocene volcanic and volcaniclastic rocks and gold, silver, copper, and lead, zinc mineralization-alteration is not confirmed in the Quaternary System. Diorite porphyry bodies have intruded into andesite of similar nature near the Selogiri Deposit in the western part. On the other hand, many intrusive bodies are observed such as diorite-quartz diorite, basalt, dacite and others. In the Seweden District dacite occurs closely associated with hydrothermal alteration zones, and caused recrystallization of Middle Miocene to Pliocene limestone in the vicinity. Thus the mineralization is considered to have occurred from Middle Miocene to Pliocene. Also the age of granodiorite exposed near Purwodadi is 17.8Ma、 namely Miocene.

Results of age determination shows that the rock in the Selogiri district in the western area and those near the mineralized zones of Seweden and Tempursari districts in the eastern area of the survey area also show 10 - 24 Ma (Miocene). This fact indicates that there are very small differences in age between the rocks of eastern and western areas. The only notable difference is the somewhat younger 10 Ma of quartz porphyry to the south of Malang. This is in contrast to the survey area of the first year where Oligocene rocks occur.

(4) Distribution of mineralization and structural control in the geochemical regional area

The geologic structure of the western part is characterized by faults of the NE-SW and NW-SE systems and homocline structure striking in the ENE-WSW direction with southward dip. Although exposures where attitude of the units can be measured are limited and the geologic structure is not clear, but it is seen that in the western part of the survey area, pre-Tertiary System occurs in the north which is overlain by younger Tertiary System southward. Regionally, western to central Java consists of Cretaceous accretionary zone, while eastern Java is believed to be Cenozoic accretionary zone. The boundary of the two zones is considered to extend in the ENE-WSW direction in the western area and this does not contradict the structure laid out above. Most probably this region was under N-S compressional stress after the Tertiary period.

The geology of the eastern area is characterized by faults of the NE-SW and NW-SE systems. The distribution of the faults, however, is dense in the western margin but is sparse from the central to the eastern part.

On the other hand, quartz veins associated with old, silver, copper, lead, and zinc mineralization are predominantly N-S trending in both Selogiri in the western area and Prambon and Seweden in the eastern area. Therefore, as with the hypothesis tabled during the first year, these quartz veins are interpreted to have formed in the tensional fissures formed in regional N-S compressional field. It is also noted that there are alteration zones which are inferred to extend in the N-S direction more or less parallel to the direction of the ore veins.

The distribution of Au anomalies is, in some areas, arranged along the NE-SW trending faults.

From the above, it is seen that the mineralization of this area is controlled in the NE-SW direction by regional structure, and individual veins are controlled in the N-S direction.

(5) Igneous rocks associated with mineralization of the geochemical regional area

In the geochemical survey (regional) area, various igneous rocks considered to be related to mineralization occur in the districts. The major rocks are; equigranular holocrystalline rocks such as granite ~ diorite, and basalt (dolerite), andesite (porphyry), and dacite (quartz porphyry). The outline of the distribution is:

(a) Selogiri District: amphibole andesite (diorite porphyry) bodies occur nearby, and the age is 21.7 Ma.

(b) In Prambon, andesite (quartz diorite: 21Ma) bodies have intruded into andesite volcaniclastics (Mandalika Formation) which is believed to be of similar age.

(c) Many quartz diorite to granodiorite (14.6Ma) bodies are exposed in Sentul East. Limestone in the vicinity have not been thermally metamorphosed nor mineralized. But skarn minerals have been confirmed in some parts, and geochemical anomalies have been detected in localities with hinterland mainly consisting of diorite indicating the possibility of been related to mineralization.

(d) In Seweden, quartz veins occur in silicified and argillized dacite and alteration occurs widely in the vicinity.

(e) At Purwodadi, the age of quartz diorite-diorite bodies is 17.8Ma and that of quartz porphyry 18.2Ma. In both localities, although in thin veins, chalcopyrite and sphalerite occur in quartz veinlets in andesite nearby, indicating association with mineralization.

(f) Diorite bodies exposed in the Tempursari District contain quartz veinlets and pyrite dissemination is notable. The age was not determined for this rock, but andesite to the south is 16.5Ma.

(6) Zonation of alteration zones in the geochemical regional area

Within the geochemical survey (regional) area, sericitization and argillization characterized by kaolin minerals and smectite are developed in the Prambon and Seweden districts. Although possibility of weathering cannot be ignored for some of the kaolin minerals, pyrite dissemination and the mode of occurrence of quartz veins indicate hydrothermal origin. In other districts argillization is predominant and sericitization is not clear.

(7) Mineralization environment of the geochemical regional area

Of the quartz veins in the geochemical survey (regional) area, the homogenization temperature of quartz veins in the Selogiri District is 330°C in average and the salinity is 4%, these are relatively high values for auriferous quartz veins. This is understood by considering the content of chalcopyrite and sphalerite and the deeper zones where genesis took place. The quartz veins in the basement rocks to the south of Klaten also showed 330°C and 5%. The quartz veins containing chalcopyrite at Purwodadi showed 257°C and 2.4%. These facts indicate that the major parts of the gold mineralization are exposed in the above three localities and vicinity, but possibility still exists for base metal deposit occurrence in deeper zones.

On the other hand, the homogenization temperature and salinity are low at 200°C and 1% for quartz veins at Prambon. This is in harmony with the observed chalcedonic quartz and indicates the possibility of mineralization extending into deeper zones.

The temperatures are uneven for samples from Tempursari, average is high at 300°C and is harmonious with the mode of occurrence of alteration zones in the vicinity.

Although the number of samples is relatively small, the quartz veins of the geochemical survey (regional) area can be divided into; a group with high temperature and relatively high salinity, and a group with relatively high temperature ranging from 250~300°C and low salinity of 1.6~2.3%. The high-temperature group occurs in the vicinity of holocrystalline rock bodies with base metal showings, and it is highly possible that erosion progressed to zones deeper than other localities. Thus mineral potential for relatively high-temperature poly-metallic veins, skarn deposits, and porphyry copper type deposits is considered to be higher than for epithermal gold silver deposits in these localities. Accidental skarn minerals were found during the survey, but skarn mineralization was not observed. The geology near Tempursari generally consists of quartz, chlorite, carbonate minerals, and smectite, but biotite-like mineral was found from a sample (No. I077), and it is interesting to note the possibility of exposure of potash alteration in the central part of argillization and propylitization.

Assay of ore samples showed that the grade of most of the quartz veins in the geochemical survey area do not warrant mining as gold ore except for the sample from Selogiri. However, we believe that gold and silver mineralization can be located by survey of the upper reaches of geochemical anomalies. Although there are no operating copper, lead, and zinc mines, but copper mineralization near the Selogiri Gold Deposit is intensive and very interesting.

From the above, it is inferred that in this area, epithermal gold and silver mineralization and deeper zones are exposed, and that higher temperature copper, lead, zinc mineralization is developed.

(8) Regional structural control

Although far east of the geochemical survey (regional) area, Batu Hijau mine is operating in the Sumbawa Island where the geologic environment is similar. On the other hand, gold deposits of the Pongkor mine occur in the western Java to the west of the survey area. Near the Pongkor mine, Tertiary volcanic rocks are also developed and the host rocks of their quartz veins are these volcanic rocks. The difference is that mineralization also occurs in Pliocene volcanic rocks. Thus it is necessary to understand the geologic structural control of gold mineralization by comparative study of Pongkor deposit and the mineralization of the study area (Selogiri deposit). The regional geologic structure inferred at present is as follows. The arrangement of the Cretaceous and Tertiary accretionary zones is in the ENE-WSW direction which is slightly oblique to the direction of the present trench. Therefore in western Java Cretaceous accretionary zone is exposed and Tertiary accretionary zone is exposed in eastern Java and the boundary of the two zones extends across the geochemical survey (regional) area. Thus it is inferred that older compressional field in the NNW-SSE direction affected the western area, while younger N-S compressional field affected the eastern area. Facts conforming to this hypothesis are not conclusive. They are; ENE-WSW strike is dominant for the units in the western area, and although not very clear, folds with E-W trending anticlinal and synclinal axes occur from the central to the western area. This needs to be verified in the future.

It seems that NE-SW faults largely control the geologic structure in the central part of the western area. Namely homocline Tertiary System with southern dip in the western side does not continue to the eastern side, pre-Tertiary System which occurs in the western side does not exist in the eastern side. The limestone of the Upper Tertiary Wonosari Formation is cut by the faults, but its overall distribution seems to be unaffected. These facts lead us to believe that (a) Wonosari Formation and the underlying Mandalika Formation is unconformable in some parts, and (b) the faults which controlled the underlying Mandalika Formation were not very active after the deposition of the Wonosari Formation. Although probably of small scale, NW-SE faults which cross the NE-SW faults obliquely arouse interest because they possibly control the distribution of mineralization of Selogiri deposit and the vicinity. The fissures host to the quartz veins of the Selogiri deposit extends in the N-S direction, but as N-S faults do not exist in the vicinity the nature of the fissure would have stronger tensional nature. Under this assumption, the deposit is younger than the very active period of the N-W system faults. In other words, the deposits are considered to have formed under geologic environment closer to the present N-S compressional stress field.

4 - 2 Ore potential

4-1-1 Regional Geochemical Survey Area

Gold, silver, copper, lead, zinc mineralization were confirmed in the second-year geochemical regional area. Manganese mineralization was also found, but it was of small scale. The gold, silver, copper, lead, zinc mineralization mainly occurs as quartz veins bearing chalcopyrite, galena, and sphalerite. Also skarn minerals were found in mining concession area, and associated base metal mineralization is inferred to occur. Gold, silver, copper, lead, zinc, molybdenum geochemical anomalies were also detected.

The present geochemical regional survey indicates that the major mineralization occurs at the following localities.

(a) Selogiri district: Selogiri deposit and auriferous quartz veins in the vicinity at the eastern margin of the western area.

(b) Prambon district: Quartz vein zones (Au, Ag anomalies) to the north of Trenggalek in the western margin of the eastern area.

(c) Sentul district: Silicified zone to the southwest of Trenggalek in the southwestern margin of the eastern area.

(d) Observed Au, Cu mineralization (G.Klitik) in the alteration zones to the south of Blitar in the central part of the eastern area.

(e) Purwodadi district: Cu, Au mineralized alteration zone to the southeast of Malang.

(f) Tempursari district: Au, Cu mineralized alteration zones.

(g) K.Jinggring district: Au geochemical anomalies to the south of Tulungagung in the western part of the eastern area.

(h) Seweden East district: Geochemical anomalies, quartz veinlets, and alteration zones near the Royal Indo Tama Concession.

(i) Purwoharjo district: Continuous Cu anomalous zones to the northeast of Purwodadi district.

Of the above, surface mineralization is confirmed as well as geochemical anomalies in 6 districts from (a) to (f). Mineral potential is considered to be particularly high at the following 3 districts, namely in Selogiri district (a) mineralized alteration zones are distributed around presently working small mine, in Prambon district (b) gold mineralization, although of low grade, is found in epithermal quartz veins, and in Sentul district (d) alteration occurs widely and gold and copper mineralization occurs in quartz veinlets.

4-1-2 Geological survey area

Gold and copper geochemical anomalies in semi-detailed geochemical areas concentrate in the following four areas: tentatively named as Ponorogo south Lorok Pacitan and Purwoharjo area. Quartz vein and Silicified rocks distributed in Ponorogo south, Lorok and Purwoharjo area.

4-1-3 Geological survey area

Semi-detailed geological survey was carried out in the Prambon district within the geochemical regional survey area and in the Ponorogo South district within the semi-detailed geochemical survey area. The following districts were extracted as promising districts for mineral exploration.

(1) Outline of the survey results of the Ponorogo South district

This district is further divided into eastern and western districts. The eastern part is called Cepoko district and its area is 8km E-W and 2km N-S. The western part is called Nepo district and the area is 2km E-W and 3.5km N-S.

Geology: The geology of the Ponorogo South district consists mainly of Oligocene to Miocene volcanic and volcaniclastic (Mandalika Formation) rocks with intercalation of limestone. The volcanic to volcaniclastic rocks are basalt~andesitic to dacite~rhyolitic. Also intrusive bodies of diorite, quartz diorite, basalt, andesite and dacite are exposed. Regarding mineralization of the survey area, silicified and argillized alteration zones are widely developed in the Ponorogo South district.

Mineralization: Occurrence of gold – silver mineralization is inferred in the Ponorogo district from geochemical anomalies. Surface geological survey was carried out on the basis of this inference and confirmed silicified zones and quartz veins containing chalcopyrite in the eastern part of the Cepoko district and this is believed to be the source of Ag anomalies. The source of Au anomalies in the western part of the Cepoko district is inferred to be silicified veins near argillized rhyolite~dacite bodies. Notable mineralization was not confirmed in the drainage basin with Au anomalies in the Nepo district. But chalcopyrite-bearing quartz veins were confirmed in the Nepo district and if the veins observed in two outcrops are the same vein, its extension in the strike direction would exceed 1 km.

Structural control: Faults of NE-SW system is developed in the Cepoko district, and those of NE-SW~NNE-SSW system in the Nepo district. The direction of the dikes is predominantly N-S.

The faults in the Nepo district are believed to control the gold, silver, copper, lead, zinc mineralization associated with quartz veins, which will be mentioned later. The faults distributed in the eastern part of the Cepoko district occur in the quartz vein and silicified zones and they displace parts of the quartz veins, their relation to mineralization is a matter to be studied further but the faults and mineralization were possibly both active simultaneously.

(2) Outline of the survey results of the Prambon district

Geology: The geology of this district consists mainly of Oligocene to Miocene volcanic and volcaniclastic rocks with intercalation of limestone. The volcanic and volcaniclastic rocks are basaltic to andesitic in nature. These rocks are roughly correlated to Mandalika Formation. Bedding is developed in the fine to coarse tuff in the northwestern and southwestern parts and it is correlated to Jaten Formation. Also basalt lava occurs above the volcaniclastic rocks in the southwestern part. In the present report, basalt lava is included in the Jaten Formation. Quaternary volcanic rocks are distributed in the northwestern part of the district. Regarding intrusive rocks, diorite-quartz diorite, basalt, and andesite bodies are exposed.

Geologic structure: Stratification is poor in the formations of the Prambon district and details of geologic structure are not clear. The dip of the strata is generally gentle and existence of small-scale fold structure with NE-SW or N-S trending axes is inferred. Faults are dominantly of NE-SW system. The distribution of limestone and the topography indicate that the formations have been largely displaced particularly in the eastern part. The direction of the extension of intrusive bodies varies from N-S to NE-SW~ENE-WSW and NW-SE, but N-S is the dominant direction.

Mineralization: In the Prambon district, mineralized alteration zones stronger relative to the gold and silver mineralization assumed at the time of planning were confirmed. Particular notice is warranted along the Sumurup and Beloran Rivers where 1m wide lead-zinc-bearing quartz veins are exposed. Silicified veins with pyrite dissemination occur, and silicified floaters are distributed widely in the mountains between the two rivers. Judging from the exposure along the two rivers and the floaters, the extension of the lead-zinc-bearing quartz vein zone in the strike direction is estimated to exceed 1km. In this part of the district, mineralization is estimated to have occurred in an area of 2km N-S and 3km E-W including the above. Also gold-copper-bearing quartz and silicified veins are distributed along the Suren River to the north of Sumurup and Beloran Rivers. These veins are less than 70cm wide, but they continue for more than 1km intermittently as a zone. Dioritic intrusive bodies occur to the north of the Suren River, and leucocratic alteration zones are widely developed in the vicinity.

(3) Mineral potential of the geological survey area

Deposits consisting mainly of copper-bearing quartz veins can be expected to occur in the Ponorogo South district. The past survey confirmed only one such quartz vein with 1~1.5m thickness and 1~2km strike direction extension, but existence of quartz veins are anticipated in the silicified zones in the footwall side and/or northward extension of the Salak River. The deeper zones near the barren quartz veins along the Nepo River should also be investigated.

In the Prambon district, lead-zinc-bearing quartz veins along the Sumurup River, the lead-zinc-bearing quartz veins along the Beloran River and the silicified veins (gold mineralization is inferred) near the summit of the mountain between the above two rivers, and further gold-copper-bearing quartz vein zone along the Suren River are believed to be most promising regarding metal potential. The gold showings in the southern part of the Prambon district is considered to be of smaller scale compared to the gold-lead, zinc-copper mineralized zones.

Table 1-6　Major Geochemical Anomaly Zones

District	Geochemical anomaly	Mineralization	Expected type of ore deposits
C1. Selogiri	Stream sediments: Au, Ag, Cu, Pb, Zn, As, Sb, Hg Panning: Cu Rock:21g/tAu(max)	-chalcopyrite-sphalerite-quartz veins -sericite alteration （surrounding Selogiri deposits）	Au-Ag-quartz vein (possible porphyry copper at depth?)
C2. Prambon	Stream sediments: Au, Ag, As, Sb, Mo Panning: Au Rock:0.8 g/t Au	-quartz vein, pyrite dissemination -sericite alteration	Au-Ag-quartz vein (possible porphyry copper at depth?)
C3. Sentul East	Stream sediments: Au, Ag, Zn, As, Sb, Hg, Mo Panning: As Rock:0.3 g/t Au(max)	-Silicification, quartz vein -Strong pyrite dissemination -Argillization (Kaolin, etc.)	Epithermal quartz vein
C4. Seweden	Stream sediments: Au, Zn, As, Sb, Mo Panning: Cu Rock:0.2 g/t Au(max) 1.1% Cu (max)	-Wide alteration zone, quartz veinlets -Sericite alteration Kaolin alteration	Au-Ag-quartz vein (possible porphyry copper at depth?)
C5. Purwodadi	Stream sediments: Ag, Pb, Zn, As, Sb, Mo, As, Hg Panning: Au Rock: 1.0g/t Au (max) 0.7% Cu (max)	-quartz, chalcopyrite veinlets -Granite intrusion (pyrite dissemination)	Base mental quartz vein (Skarn type?)
C6. Tempursari	Stream sediments: Au, Cu, As Panning: Au Rock:0.08g/tAu(max) 0.7%Cu(max)	-Wide alteration, quartz veinlets	? (porphyry copper type?)

Table 1-6　Major Geochemical Anomaly Zones(continued)

District	Geochemical anomaly	Mineralization	Expected type of ore deposits
C7. Wonosari	Stream sediments: Au, Ag, Cu, Zn, As, Mo, Hg Panning: Au Rock:0.04g/tAu(max)	? (Covered with limestone)	?
C8. Seweden East (Ringinrejo and to the north)	Stream sediments: Au, Ag, Cu, As, Mo Panning: Au Rock:0.7 g/t Au(max)	-quartz veinlets, Pyrite dissemination	Au Ag quartz vein
C9. K. Jingring	Stream sediments: Au Rock:0.9 g/t Au(max)	-quartz vein, limited alteration zone -quartz float	Au Ag quartz vein

Chapter 5 Conclusions and Recommendations

5 - 1 Conclusions

Geochemical reconnaissance survey, geochemical semi-detailed survey, and geological survey was carried out during the second year of the East Java cooperative mineral exploration project, and arrived at the following conclusions.

5-1-1 Conclusions of the regional geochemical survey

The following are concluded to be the major mineralized zones.

(1) Selogiri district: Selogiri deposit in the eastern margin of the western area and auriferous quartz veins in the vicinity.

(2) Prambon district: Quartz veins (gold, silver anomalies) to the north of Trenggalek in the southwestern part of the eastern area of the district.

(3) Sentul district: Silicified zones to the southwest of Trenggalek.

(4) Seweden district: Alteration zones associated with gold, copper mineralization to the south of Blitar in the central part of eastern area of the district.

(5) Purwodadi district: Copper, gold mineralized and altered zones to the southeast of Malang.

(6) Tempursari district: Gold, copper mineralized and altered zones.

(7) K. Jinggring district: Gold anomalous zones to the south of Tulungagung in the western part of the eastern area.

(8) Seweden East district: Geochemical anomalies, quartz veinlets, alteration zones near the Royal Indotama Concession

(9) Purwoharjo district: Copper anomaly zone continuing northeastward from this district.

Of the above, surface mineralization is confirmed as well as geochemical anomalies in 6 districts from (1) to (6). Mineral potential is considered to be particularly high at the following 3 districts, namely in Selogiri district (1) mineralized alteration zones are distributed around presently working small mine, in Prambon district (2) gold mineralization, although of low grade, is found in epithermal quartz veins, and in Seweden district (4) alteration occurs widely and gold and copper mineralization occurs in quartz veinlets.

5-1-2 Conclusions of the semi-detailed geochemical survey

(1) Ponorogo south district: Au, Ag, Pb anomalies occur near wide developing silicified zone with pyrite dissemination to south of Ponorogo. The area may extend over the Slahung South anomalies zone identified by the Phase 1 regional survey.
(2) Lorok district: Au, Ag, As anomalies occur over the alteration area identified by phase 1 survey.
(3) Kasihan district: Cu, Pb, Zn anomalies occur near the Kasihan skarn deposit.
(4) Pacitan district: Ag, As, Mo anomalies occur to east of Pacitan. Micro-granodiorite intrudes into Oligocene-Miocene sediments and volcanics.
(5) Nawangan district: Cu, Pb, Zn and Mo occur over Oligocene-Miocene volcanics distributed area. Many quartz veins are exposed in this area. Quartz veins are accompanied by chalcopyrite, galena and sphalerite.
(6) Purwoharjo district: Au, Ag, As anomalies occur over the silicified zone identified during this survey. In this area, quartz veins also are exposed.

5-1-3 Conclusions of the geological survey

Deposits consisting mainly of copper-bearing quartz veins can be expected to occur in the Ponorogo South district. The past survey confirmed only one such quartz vein with 1~1.5 m thickness and 1~2km strike direction extension, but existence of quartz veins are anticipated in the silicified zones in the footwall side and/or northward extension of the Salak River.

In the Prambon district, lead-zinc-bearing quartz veins along the Sumurup River, the lead-zinc-bearing quartz veins along the Beloran River and the silicified veins (gold mineralization is inferred) near the summit of the mountain between the above two rivers, and further gold-copper-bearing quartz vein zone along the Suren River are believed to be most promising regarding metal potential.

5-1-4 Summary of conclusions

The mineral potential of the following six areas are considered to be particularly high.
(1) Geological survey area
  (a) Ponorogo South district; chalcopyrite-bearing quartz vein zone near the Nepo River.
  (b) Prambon district; gold-lead-zinc-bearing quartz vein zone along the Suren, Sumurup, Beloran

Rivers.

(2) Semi-detailed geochemical survey area

Gold, copper and pathfinder element geochemical anomalies in semi-detailed geochemical area concentrate in the following six areas: tentatively named as Ponorogo South, Lorok, Kasihan, Pacitan, Nawangan and Purwoharjo district. Besides Ponorogo South district, four districts are promising:

(c) Lorok district

(d) Pacitan district

(e) Nawangan district

(f) Purwoharjo district.

(3) Geochemical reconnaissance survey area

(g) Vicinity of Selogiri gold deposit.

(h) Southern extension of the alteration zone near Seweden.

Of the above, (a) is located within the geological survey area, and (b) in semi-detailed geochemical survey area, but further detailed survey is necessary in (b) for planning drilling. Only regional geochemical survey has been carried out in (g) and (h), but the target of (g) is the gold-bearing quartz veins similar to known deposits. Regarding (h) the type of mineralization cannot be determined, but the gold and silver showings and the alteration zone is extensive, and thus extensive hydrothermal system perhaps exceeding that of (b) can be expected, and there are possibilities of the occurrence of large-scale gold-bearing quartz veins or porphyry copper deposits.

5 - 2 Recommendations

5-2-1 Recommendations regarding geochemical reconnaissance area

It is recommended that geological survey be carried out in the following (1) and (3)~(6) districts on the basis of the conclusions regarding geochemical reconnaissance area, and it is also recommended that detailed geochemical survey of soil and rocks be carried out and drilling targets be extracted simultaneously. Then mineral potential of each district should be comparatively examined and drilling be carried out in the most promising zones. Where the high-potential targets are not confined only to veins and are extensive in area, it is recommended that IP electric survey (profile line length in the order of 10km) be carried out before drilling. (Geophysical survey: pyrite dissemination is expected to occur in mineralized zones expected in the area such as epithermal hydrothermal deposits and porphyry copper bodies, and IP electric is considered to be the best method to apply). Also scout survey should be carried out in the following (7)~(9) districts for understanding the cause of the geochemical anomalies in conjunction with semi-detailed geological survey. Geological survey of (2) district will be mentioned in 5-2-3.

(1) Selogiri district: Selogiri deposit in the eastern margin of the western area and auriferous quartz veins in the vicinity.
(2) Prambon district: Quartz veins (gold, silver anomalies) to the north of Trenggalek in the southwestern part of the eastern area of the district.
(3) Sentul district: Silicified zones to the southwest of Trenggalek.
(4) Seweden district: Alteration zones associated with gold, copper mineralization to the south of Blitar in the central part of eastern area of the district.
(5) Purwodadi district: Copper, gold mineralized and altered zones to the southeast of Malang.
(6) Tempursari district: Gold, copper mineralized and altered zones.
(7) K. Jinggring district: Gold anomalous zones to the south of Tulungagung in the western part of the eastern area.
(8) Seweden East: Geochemical anomalies, quartz veinlets, alteration zones near the Royal Indotama Concession
(9) Purworejo district: Copper anomaly zone continuing northeastward from this district.

5-2-2 Recommendations regarding semi-detailed geochemical survey area

Base on the result of semi-detailed geochemical survey, it is recommend that the following survey will be carried out as the next survey of the East Java mineral exploration project. It will be assesed the ore potential and extracted promising area for further drilling by detailed geological survey and soil geochemical survey.

(1) Ponorogo south district: Silicified zone and quartz vein zone in east side of semi-detailed area (around Slahung)

(2) Lorok district: Mineralized area around Lorok village and Lorok river

(3) Pacitan district: Intrusive distributed area in southern part of semi-detailed area

(4) Purwoharjo district: Silicified zone and quartz vein area in northwest part of semi-detailed area

5-2-3 Recommendations regarding geological survey area

It is recommended for the third year, that drilling be carried out in the Ponorogo South and Prambon districts which were delineated by the present survey.

(1) Ponorogo South district: Extension of the copper-bearing quartz vein along the Salak River is the target for drilling to be expected to occur in 1~2 km strike direction.

(2) Prambon district: Lead-zinc-bearing quartz veins along the Sumurup River, the lead-zinc-bearing quartz veins along the Beloran River and the silicified veins (gold mineralization is inferred) near the summit of the mountain between the above two rivers, and further gold-copper-bearing quartz vein zone along the Suren River are the most promising target for drilling.

5-2-4 Summary of recommendations

Prambon district (Suren River・Sumurup River~Beloran River zone) and Ponorogo South district (Nepo River zone) were extracted for drilling based on the results of geological survey carried out by the recommendations of geochemical reconnaissance and geochemical semi-detailed surveys carried out during this year. For Suren River・Sumurup River~Beloran River zone, however, the areal extent of the target should be clarified by soil geochemical survey before drilling.

Regarding Selogiri and Seweden districts extracted by geochemical reconnaissance (stream sediments), and Lorok, Pacitan, and Purwoharjo districts extracted by geochemical detailed survey (stream sediments), it is recommended that drilling targets be extracted by detailed geochemical survey (soil) or by geophysical survey and drilling be carried out.

If available time is restricted, the Nepo River district should be drilled first and drilling priority should be determined simultaneously by soil geochemical survey of Suren River・Sumurup River~Beloran River, geochemical survey of Selogiri, Lorok, Pacitan, and Purwoharjo districts and detailed survey of the Seweden district including geophysical survey.

The above recommendations are summarized as follows.

a) Ponorogo South district: drilling.
b) Prambon district: geological survey・soil geochemical survey → drilling.
c) Lorok district: geological survey・soil geochemical survey → drilling if warranted.
d) Pacitan district: geological survey・soil geochemical survey → drilling if warranted.
e) Purwoharjo district: geological survey・soil geochemical survey → drilling if warranted.
f) Selogiri district: geological survey・soil geochemical survey → drilling if warranted.
g) Seweden district: geological survey・geophysical survey → drilling if warranted.

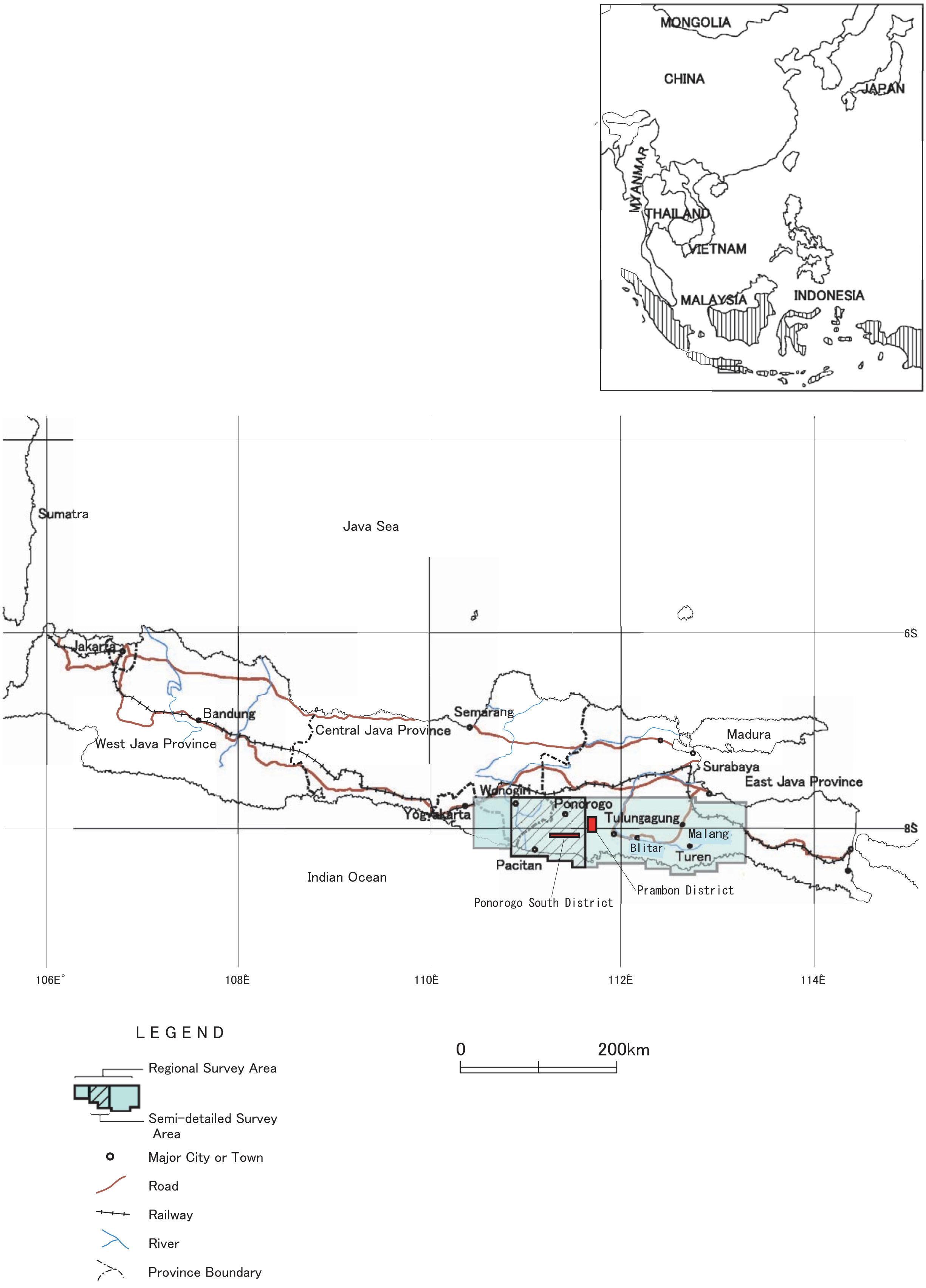


Fig.1-1 Location Map of the Project Area

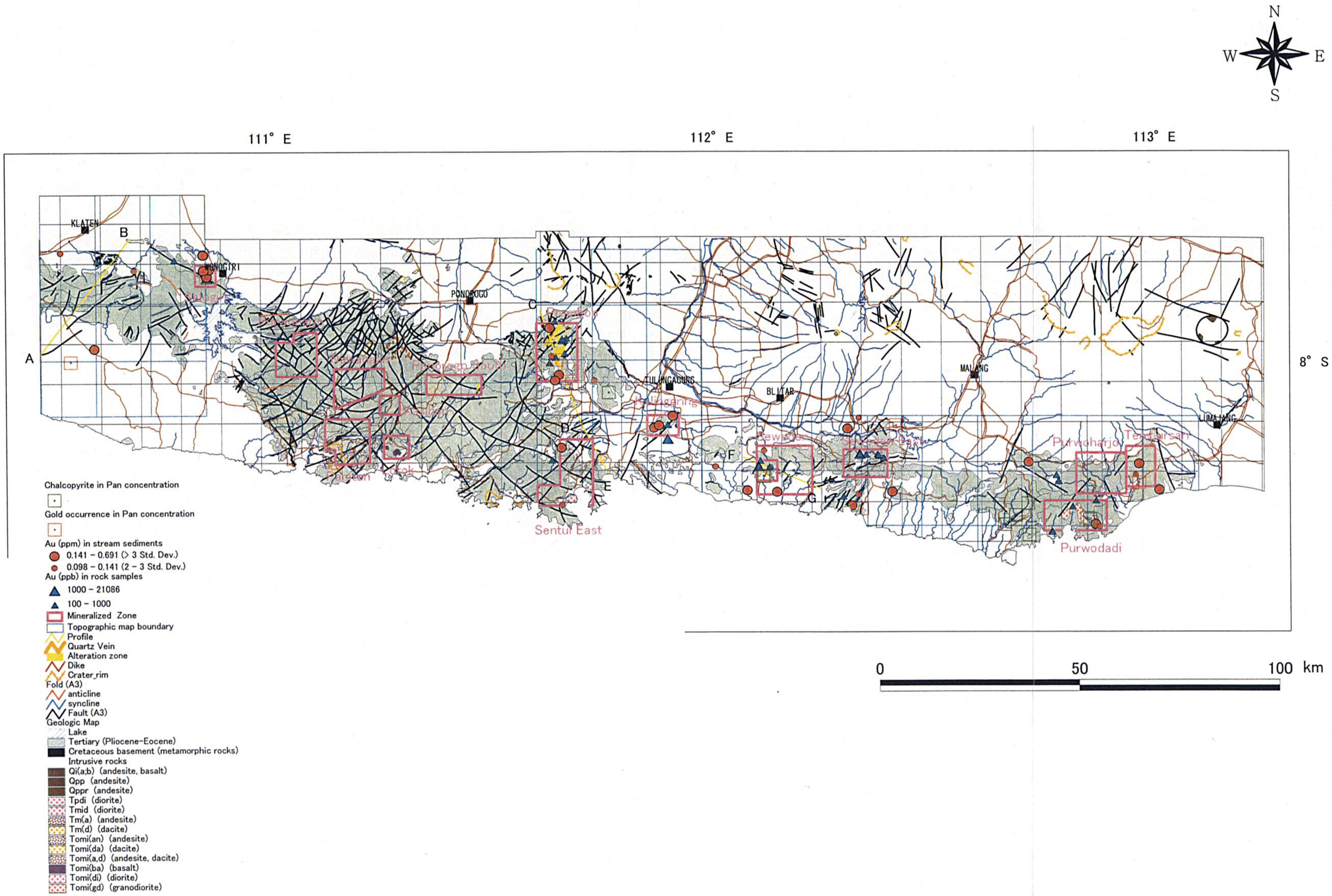


Fig. 1-2 Compilation Map of the Phase2 Survey Results

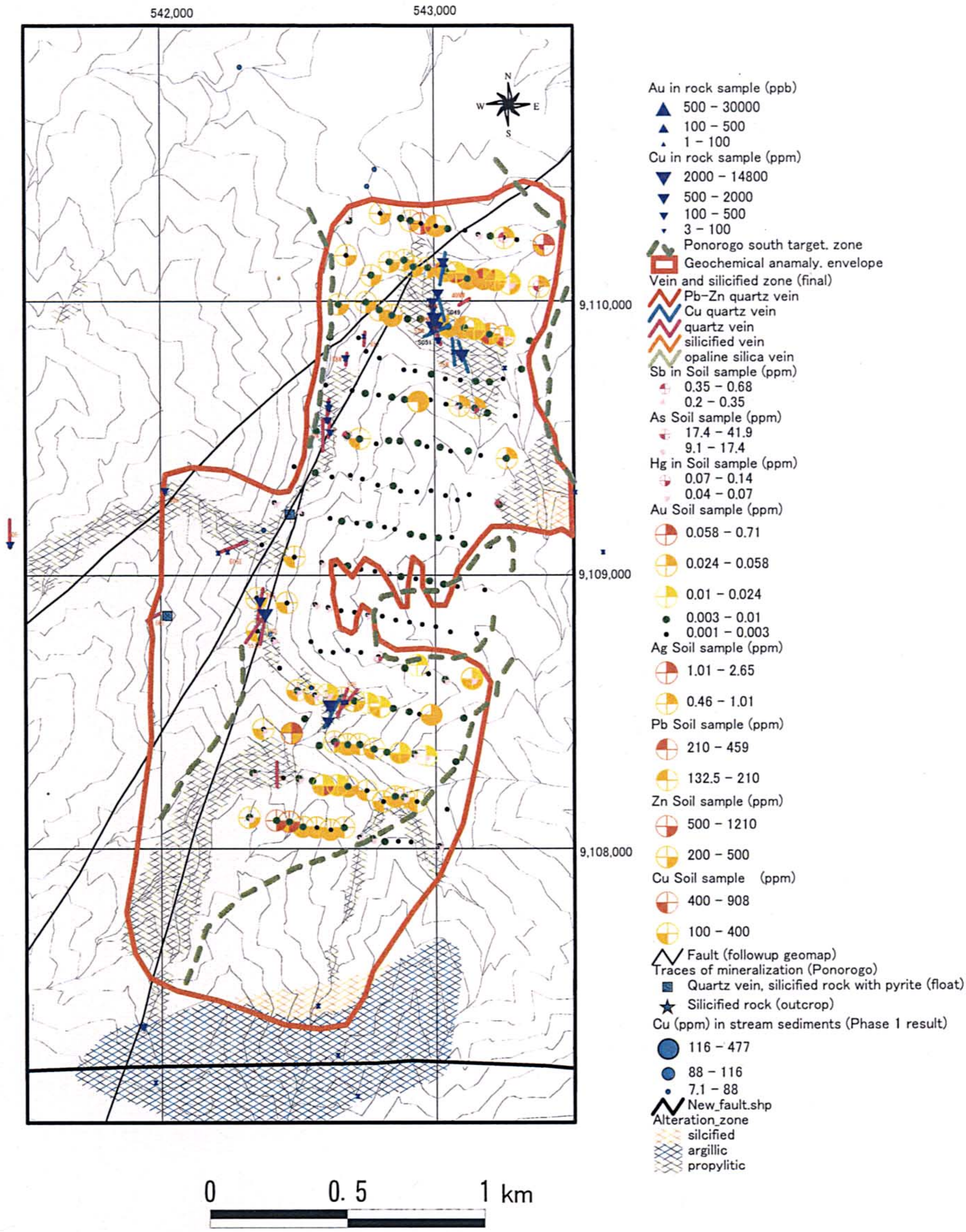


Fig. 1-3 Compilation Map of the Ponorogo South District (Nepo River Sub-district)

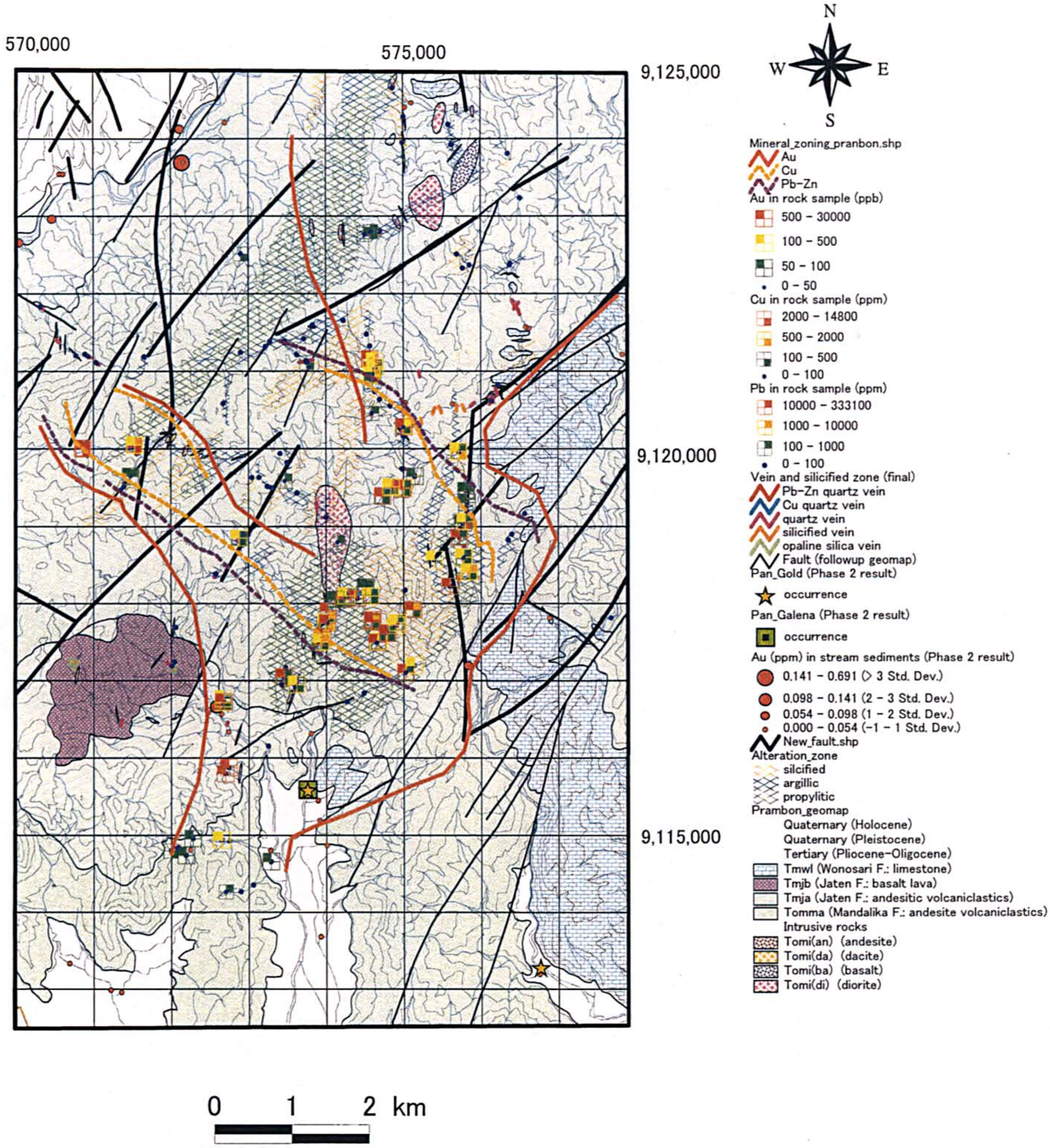


Fig. 1-4 Compilation Map of the Prambon District

PART II

DETAILED DISCUSSION

Chapter 1　Analyses of Existing Data

PART II　DETAILED DISCUSSIONS

Chapter 1　Analyses of Existing Data

1 - 1　Existing Geological Information

Existing geological information of the project area is shown in the list of references.　And the major ones are laid out in Table 1-1.　Sites for geochemical sampling were determined by the analysis of existing data.　The area delineated for present-year survey was considered to have particular importance within the total study area.

Table 2-1　Major Mineralization Occurrences Based on Existing Data

No.	Name	Commodity	Geology	Mineralization	Previous Work
1	Selogiri	Au	Andesitic tuff Microdiorite	Quartz vein:3 main veins, 5-40cm wide, 500m long, cp, gn, sp	Shallow drilling Test pitting
2	Kebonsari	Au	Dacite-andesite breccia	Quartz stockwork, 25cm wide, cp, gn, sp	Test pitting Drilling(5holes, 820m)
3	Petung-sinarang Burungkah	Au	Andesite-basalt	Quartz stockwork and veins, Silicification, sp, py, gn	Tunneling Drilling(9 holes, 492m)
4	Kasihan Kobasari	Cu, Pb, Zn	Andesite breccia	Cu, Pb-Zn skarn(Cu porphyry) Quartz vein, cp, sp	Drilling Year1991-94:7 holes, 1, 005m. (Year1996-98:5 holes, 499m)
5	G. Mas, Selogiri	Au	Andesite-basalt	Quartz stockwork and veins	Trenching
6	Pulung	Au	Andesite(lava, tuff)	Quartz vein and veinlets	-
7	Tegalombo	Au	Dacite Andesite, Andesite breccia	Vein along the andesite dyke	-
8	G. Domasan, Slahung	Cu, Zn	Andesite breccia	Quartz vein	
9	K. Gondang Panggul	Ag	Dacite	Quartz vein	-

Note: Py:pyrite cp:chalocpyrite, sp:sphalerite, gn:galena

(1) Outline

The description of this chapter is based on the exiting data that are summarized the survey conducted by PT. Aneka Tambang in 1996 and 1997. The survey consists of geological survey, geochemical prospecting, Geophysical Survey by IP method and drilling. The survey area covers their concession (KP.DU597/JATIM) consisting of Block A and Block B. The areal extent of the concession is about $796km^{2.}$ The area is located in the central to the southeastern part of the phase 1 geological and geochemical survey area. In the concession there are mineral occurrences such as Gunung Mongi, Baosan Kidul, Candi-Pule, Tugu-Kali Duren, Dalangturu-Suruh-Gading, Munjungan.

(2) Geology

The geology of the area is comprised of Tertiary volcanics and volcaniclastics, sedimentary rocks and limestone of Oligocene to Miocene age , Pliocene sedimentary and limestone, and alluvium. The Oligocene to Lower Miocene rocks divided into Mandalika Formation, Arjosari, Watupatok Formation, Semilir formation, and Campurdarat Formation, and Middle to Upper Miocene to Jaten Formation, Wuni Formation, Nampol Formation, Oyo Formation and Wonosari Formation. The Pliocene is termed Kali Pucung Formation..

(3) Mineral Occurences

The concession KP.DU597of the area extent of $796km^2$ is divided into Block A and Block B, covering areas of $394km^2$ and $120km^2$, respectively. In the Block A, mineral occurrences of Candi-Pule, Tugu-K.Duren, Dalangturu, Suruh-Gading, Sengunglung, Besuki-Kebonsari, Pringwulung-Pandeyan and Bangun-Prigi are located. In the Block B, mineral occurrences of Gunng Mongi, Kali Picis and Baosan Kidul are located.

1 - 2 Amount of Previous Work

The amount of work conducted is as follows.

Year	1996	1997	1998
Geologic Mapping Area (scale)	77.5km^2（1:5,000） 3km^2（1:2, 500）	92.5km^2（1:5,000） 46.12m^2（1:2, 500)	(162.66km^2)
Pits & Trenches	1, 500m^3	5, 170m^3	
Drilling		2holes(5holes?）382.25m	(4holes, 633.65m)
Rock samples	171 pcs	2, 282 pcs	(107 pcs)
Soil samples		2, 908 pcs	-
Target mineral occurrences	Baosan Kidul Gunung Mongi	Baosan Kidul Gunung Mongi Darangturu and others	Buluroto Sentul

1 - 3 Survey of the year 1996

(1) Outline

Mineralization was investigated in the Gunung Mongi and Baosan Kidul districts.

a. Gunung Mongi district

・Argillization, Silicification and Dissemination of pyrite were investigated.

・Quartz vein zones of up to 3.5m of width occurs, while widths of individual veins are less than 0.25m.

・An quartz vein with sphalerite returned the results of 1.7%Cu, 0.25%Pb, 9.03%Zn.

・The highest values of gold and silver are 1.05ppmAu and 74ppmAg.

b. Baosan Kidul District

・Quartz veins are found at 5 localities.

・Jirak Vein: Strike length is 1,500m, width 0.5-2.5m. The highest values of 12 samples are:0.86ppmAu, 0.82%Cu, 1.9%Pb and 4.84%Zn.

・Jrabangan Vein：Strike length is 1, 000m, The maximum width is 0.2m, 31. The 7samples is higher than 0.1ppmAu and the highest value is 1.27ppmAu.

・Beder Vein: The strike length is 1, 500m, maximum width is 2.5m. Among 81samples, 15samples is higher than 0.1ppmAu. The highest value is 2.69ppmAu.

・South of Beder vein: There are two major direction of the strike at N330°-N340°and N225°.

・Pucak Fault: Quartz veins are emplaced in the fault.

1 - 4 Survey of the year 1997

(1) Survey amount

Work	Amount	Remarks
1. Geology		District
(a)Mapping scale 1:25, 000	5, 000 ha	Candi-Pule,
scale 1:5, 000	9, 250 ha	Tugu-K.Duren
scale 1:2, 500	4, 612 ha	Dalangturu
scale 1:1, 000	550 ha	Suruh Gading
(b)Soil Analysis	2, 908 samples	Sengunglung
(c)Rock Analysis	2, 282 samples	Torongan
(d)Core sampling	22 samples	Baosan Kidul
2. Geophysics		Others
(a) IP	726 points	(Gn.Lojeh, Dongko, Panggul, Kampak
(b) Magnet	6, 082 points	Pandeyan, Bangun, .
3. Drilling		Buluroto,
(a) Holes	2 holes	Munjungan, Buluroto)
(b) Total Length	382.25m	

(2) Geological and geochemical survey

Soil Geochemical Prospecting: 100 m×100 m grid spacings

District	Description of the district	Soil sample number
Tugu-K.Duren	Data not available	137
Dalangturu	Wide silicification	261
Suruh Gading	Weak geochemical anomaly	892
Gn. Sengunglung	Weak geochemical anomaly	586
Torongan	Wide silicification	531
Baosan Kidul	Data not available	501
Total	-	2, 908

(3) Geophysical Survey

In Dalangturu district, electric prospecting with IP method and magnetic survey were conducted.

(4) Results of the Survey

a. Candi-Pule district

In Bonang sub-district and Nglodosub-district, 13 quarz veins are emplaced. The gold values are not high.

b. Tugu-K.Duren district

In 1997, outcrop of quartz vein of 5 cm in width was discovered and gold, As, Sb or Hg geochemical anomalies were extracted in Jombok, K.Gading, Gn.Candi, T.Tumpah and Bundel.

c. Gn. Dalangturu district

Follow-up of the 1996 was conducted around the silicified float zone of 800m×300m. In 1997, soil geochemical survey, geophysical survey, magnetic survey were conducted. Soil sampling covered an area of 2.3kmX1.5km, and 261 samples are collected. Au, As, Sb and Hg geochemical anomalies were extracted.

d. Suruh-Gading district

A total of 892soil samples were collected and extracted Au, As, Sb, Hg anomalies coverint 650m×200m in Suruh. Other areas were also recommended to conduct follow-up surveys. Slicification zones were found in Plaosan, Gn.Grugah-K.Blimbing, Gn.Gagak, Desa Suruh, Kolowijo, Tumpak, Tekek and Tumpak Kidang.

No.	Kocation	Dimension	Highest Au (g/t)	Anomalous element
1	Suruh	650 X 200	0.42	Au, As, Sb, Hg
2	Gn.Abang	500 X 150	0.15	Au, As, Hg
3	Gn.Grugah	700 X 150	0.14	Au, As, Sb, Hg
4	Jalan Surhh -Gading	300 X 100	0.27	Au, As, Hg
5	Kucur	250 X 50	-	Au, As
6	Juruguwi	350 X 150	0.31	Au, As, Sb, Hg
7	Gn.Kidang	250 X 50	0.26	
8	Gn. Gadung	250 X 100	-	
9	Gn. Winong	300 X 100	-	

e. Gn. Sengunglung district

Quartz vein was not found in the district. A total of 593soil samples are collected.

f. Munjungan district

Munjungan district covers wide area and is divided into:Bekusi-Kebonsari (Besuki vein, Kayuireng Puger vein, Gembse vein and narrow veins near Gn. Kambenga), Pringwulung-Pandeyan and Torongan(K.Lengkong, K.Gunturan and Gn.Tumpaklandingan mineralized zones) and Bangun (Gn. Cilik, Gn. Tumpakglaglah, K.Coban andK.Song).

g. Gn. Mongi and Sekitarnya district
Mineralization occurs in Gombong, K.Nglurah, K.Plalar and K.Kemukus areas.

h. K. Tempuran- K.Picis district
Mineralization occurs in K.Bangkong, KK. Koang, K. Puso, K.Picis.

i. Baosan Kidul distrrict
Mineralization occurs in・Jirak vein, Dlisen vein, East Dlisen vein, Jrabangan vein and Beder vein.

(5) Recommendation
Based on various surveys in 1997, follow-up surveys in Dalangturu, Pandeyan, Torongan, Gn.Senguglung were recommended.

1 - 5　Survey of the year 1998

In 1998, follow-up survey of the 1996 and 1997surveys was carried out.　The survey consisted of drilling in Sentul district.　But the results were not open as of this report writing.　The concession（KP.DU597/Jatim) is owned by PT.Fajar Mineralalami International.

1 - 6　Regional Survey by DMR

DMR conducted reconnaissance during 1995 and 1997.　Survey results are summarized below.

Fig. 2-1 Major Mineral Occurrence (based on DMR data）

No.	Name	Commodity	Geology	Mineralization	Previous Work
1	Selogiri	Au	Andesitic tuff Microdiorite	Quartz vein: 3 main veins, 5-40cm wide, 500m long, cp, gn, sp	Shallow drilling Test pitting
2	Kebonsari	Au	Dacite-andesite breccia	Quartz stockwork, 25cm wide, cp, gn, sp	Test pitting Drilling (5holes, 820m)
3	Petung-sinarang Burungkah	Au	Andesite-basalt	Quartz stockwork and veins, Silicification, sp, py, gn	Tunnelling Drilling (9 holes, 492m)

4	Kasihan Kebonsari	Cu, Pb, Zn	Andesite breccia	Cu, Pb-Zn skarn(Cu porphyry) Quartz vein, cp, sp	Drilling (Year1991-94:7 holes 1, 005m. (Year1996-98:5 holes, 499m)
5	G. Mas, Selogiri	Au	Andesite-basalt	Quartz stockwork and veins	Trenching
6	Pulung	Au	Andesite (lava, tuff)	Quartz vein and veinlets	—
7	Tegalombo	Au	Dacite Andesite, Andesite breccia	Vein along the andesite dyke	-—
8	G. Domasan, Slahung	Cu, Zn	Andesite breccia	Quartz vein	—
9	K. Gondang Panggul	Ag	Dacite	Quartz vein	-

Note: py:pyrite cp:chalocpyrite, sp:sphalrerite, gn:galena

1 - 7 Status of Concessions

Within the regional geochemical survey area, the following concession was existing as of the beginning of the survey: Five concessions are located in semi-detailed geochemical survey area, and six in regional geochemical survey area. Among those, eight are mainly for gold exploration, and two for manganese.

Title holder	Area (km^2)	Commodity	Stage	Approved date
Miracle		Au	Exploration	1999/7/10
Budimas Manganis		Mn	Exploitation	1996/8/31
Fajar Mineralalami Int.		Au	Exploration	2000/12/29
Akur, KUD	92	Au	Exploration	1999/8/6
Aneka Tambang, PT	13, 520	Au	Exploration	1999/6/1
Karya Makmur, Kop..	99	Au	Exploration	1999/8/6
Kerajinan Industri Belerang Raksa, Kop.	10	Sulfur	Exploitation	2002/1/6
Mega Budi Manganis, PT DH CV.Budimas Perdana	1, 929	Mn	Exploitation	1996/8/31
Sejahtera Arjosari, KUD.	95	Au	Exploration	1999/8/6

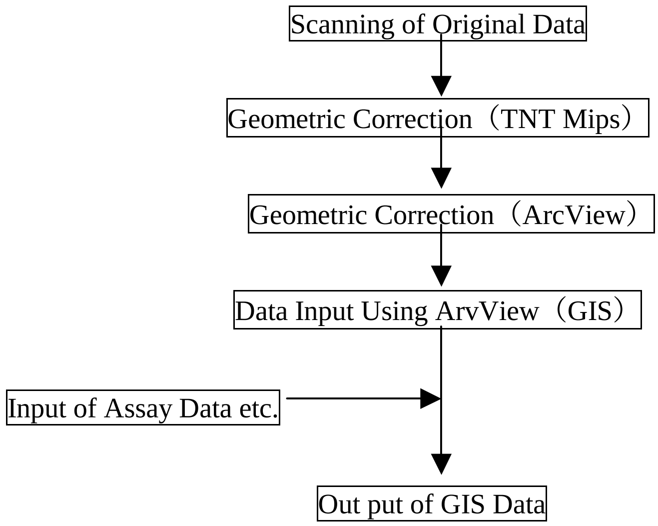
Sinar Sejahtera, Kop.	96	Au	Exploration	1999/8/6
Timah Investasi Mineral, PT		Au	Exploration	1999/8/12

1 - 8　GIS Procedure of Exiting Data

(1) Data source: 1997 survey by Aneka Tambang.

(2) Software　：TNT Mips, AcrView, MS Excel

(3) Procedure



(4) Results

The figure 2-1 shows the index of the GIS data of Dalangturu, Torongan, Baosan Kidul, Pandeyan districts.

1 - 9　Outline of Geology of the Survey Area

The geology of the survey area is composed of pre-Tertiary basement (Cretaceous System and older units), Eocene to Pleistocene volcanic and volcaniclastic rocks, Oligocene to Pliocene sedimentary rocks, Oligocene-Miocene-Holocene limestone, and Oligocene to Pleistocene intrusive bodies. Also gold, silver, copper, lead, zinc mineralization is known in this area.　The mineralization is generally considered to be epithermal activities, but the possibility of buried blind porphyry copper mineralization should not be ignored.　Also clay deposits associated with volcanism and limestone are the non-metallic deposits of this area (Fig. 2-1).

The stratigraphy of this area is as follows:

(a) Panggang Formation (Tomp): This unit occurs widely in the northern part of the survey area. It consists of basaltic to andesitic lava and volcaniclastic rocks. Sandstone is intercalated. This unit interfingers with Watupatok Formation, and is correlated to the upper part of Mandalika Formation. This is an Oligocene to Miocene marine formation.

(b) Dayakan Formation (Tomd): This unit occurs near G. Gembes in the northern part of the survey area. It consists of alternation of sandstone and mudstone.

(c) Watupatok Formation: This formation occurs in the northern part of the survey area. It consists of basaltic lava and volcaniclastic rocks. Sandstone, mudstone, chert are intercalated. It interfingers with Panggang Formation, and is correlated to the upper part of Mandalika Formation. The upper part interfingers with Semilir Formation. It is more than 500m thick.

(d) Semilir Formation: This formation occurs in the northern part of the area. This unit consists of tuff and sandstone and mudstone alternation. The lithofacies of the tuff varies significantly namely it is dacitic, andesitic, and basaltic. The bedding is generally clear. The lower part of this unit interfingers with Panggang Formation, Dayakan Formation, and Watupatok Formation while the upper part is a transition zone to Nglanggran Formation. In the southern part, this is correlated to the upper part of Arjosari Formation, and is believed to be Upper Miocene Series. The unit is more than 750m thick.

(e) Nglanggran Formation: This unit consists of basaltic to andesitic lava and volcaniclastic rocks. The volcaniclastic rocks are composed of alternation of volcanic breccia and sandy tuff (sandstone). This is believed to be shallow marine sediments. It is correlated to the upper part of Mandalika Formation. The unit is about 500m thick.

(f)Sampung Formation: This formation is distributed occurs as small unit in the northern part of the area. It consists of calcareous sandstone, marl, and limestone. Conglomerate occurs in some parts. It is correlated to Arjosari Formation and is considered to be upper Lower Miocene. This is a shallow marine sediment. It is 150m thick.

(g) Wonosari Formation: This formation consists mainly of reefal limestone, calcarenite with intercalation of conglomerate and marl. It is correlated to Upper Miocene to Pliocene Series. It is contact with andesite, but is not metamorphosed.

(h) Quaternary volcanic rocks: These rocks are distributed in the northern part of the area and are mainly composed of andesitic lava and volcaniclastic rocks. The Quaternary volcanic rocks are divided into 12 units in the Ponorogo Quadrangle map, and the thickness is indicated to be more than 2000m. The Quaternary System is not surveyed in detail during the present project and thus this is shown as one unit in the geological map. Those unconformably overlying the Tertiary System are called Lawu Lahar and is a mixture of basalt, andesite and pumice, and volcanic ash.

(i) Quaternary System: Alluvium is distributed mainly near Ponorogo, Wonogir, and along the rivers in the southern part. It consists of gravel, sand, and mud.

1 - 10 Outline of Ore Deposits of the Survey Area

(1) Outline of mineralization

Showings of gold, silver, copper, lead, zinc, and iron-manganese are known in the survey area. Gold mineralization associated with quartz veins is widely distributed particularly in the zone from Ponorogo to Pacitan. Seven holes with a total length of 1,005m were drilled by joint exploration of DMR and Korea Mining Promotion Corporation in 1993 at a mining concession 20km northeast of Pacitan, and confirmed weak copper, lead, and zinc showings. Their route maps show the occurrence of hedenbergite, magnetite, lead and copper oxide minerals, and occurrence of skarn deposits are anticipated.

(2) Mineral prospects

Forty mineral prospects are known in the survey area. Of these, 3 are gold prospects, 13 are copper, lead, zinc prospects, and 24 manganese and iron/titanium prospects. Gold mineralization is associated with quartz veins in dacite or andesite. Details regarding width and reserve are not known. On the other hand, a DMRI material (DMR, 2000) contains descriptions of 10 Au-(Cu) prospects and the Au potential of the survey area is deemed to be high. Those of Selogiri and Kebonsari are being developed and mined, although of small scale, and they warrant particular mention. The quartz veins of Selogiri are said to be 5-40cm wide, but are more than 500m long in the strike direction. The Au-Cu deposit of Kasihan is inferred to be Au-Cu porphyry copper type deposit, and 7 holes totaling 1000m in length were drilled by DMR together with Korea Mining Promotion Corporation during 1991 to 1994. Manganese deposits are all small and none are said to be mined presently. The manganese ore bodies occur as lenses at the border between Tertiary tuff and limestone. The Fe/Ti deposits are placer and/or residual deposits.

(3) Brief description of the mining concessions of the survey area

The mining concessions of the survey area are shown in Figure 1-3, and they are owned by enterprises such as; Kud. Selogiri, PT. Mega Budi Manganis, Kud Akur, PT. Sumber alam Peleng, PT. Keikan Perdana, PT. Triprasetya Pujiraharja, PT. Miracle, PT. Nomsantido, PT. Royal Indotama, PT. Everlastika, PT. Timah Investasi Mineral.

(a) Kud Selogiri: Gold deposit associated with N-S trending pyrite-quartz veins (less than 10cm wide) in andesite. There are at least 2 veins and the strike length is said to be 2km, and the present working length is about 300m. The host rock is strongly disseminated by pyrite and is sericitized and chloritized. Presently the mining is carried out at 20~40m below surface by shaft and adit. Individual bonanza extends along the dip and does not appear to extend in the strike direction. The vein-grade is said to be several tens to several hundreds g/t. The ores are ground by small mill after hand picking and the gold is recovered by amalgam method. According to DMR data, 5 holes with total extension of 820m were drilled, but the results are not shown. The reserves (gold content) are calculated to be 206kg.

(b) PT. Mega Manganis: A manganese deposit outside of the survey area at Tulungagung.

(c) Kud Akur: It is also called Kebonsari after the village name, and also Punung after the sub-district name. The main deposit is stockwork gold consisting veinlets of less than 1cm wide. The host rock is andesitic tuff breccia, but 10cm-wide quartz veins containing pyrite and chalcopyrite also occur in this deposit. Gold grade is low and that of the presently mined ores is less than 1g/t Au. Oxidized zone occurs to 10m depth and this zone is said to have several g/t Au. The ores are ground by small mill after hand picking and gold is recovered by amalgam method.

(d) PT. Sumber Alam Peleng: Quartz veinlets containing sphalerite are said to occur in andesite and dacitic porphyry. Gold grade is low and past exploration was not active.

(e) PT. Keikan Perdana: Skarn-type copper, lead, zinc deposits related to andesite lava and volcaniclastic rocks and quartz porphyry intruded into limestone occur in the Kasihan district where this concession exist. Gold grade of the ores is generally low. Sphalerite and chalcopyrite-bearing quartz veins are the main ore in at least 2 outcrops. Drilling was conducted in 1994, it is not worked at present.

(f) T. Prasetya Pujiraharja: This is described to be in Gunung Mas district, this is a gold deposit accompanying quartz and pyrite in andesitic-basaltic lava and volcaniclastic rocks. Nine holes with a total extension of 482m were drilled, and the reserves are 5.6 million tons at 1.89g/t (DMR data). It appears to have been worked in small scale up to around 1996. This area was not surveyed.

(g) Miracle: This is located to the east outside of the survey area. This consists of gold-bearing quartz veins in propylitized volcanic rocks. The maximum width of the veins is 35cm, maximum grade 2.9g/t Au, 87g/t Ag. Mining concession has expired.

(h) Nomsantindo: This is located to the east outside of the survey area. Gold mineralization is anticipated from quartz veins and silicified pebbles. But the gold content of the pebbles is low.

(i) Royal Indotama: This is located to the east outside of the survey area. Gold mineralization is observed in chalcedonic quartz-pyrite veins to stockwork within andesite, dacite and limestone. Maximum width and grade is 2m and 1.8g/t Au. Mining concession has expired.

(j) Everlastika Jaya: This is located to the east outside of the survey area. This is characterized by pyrite dissemination in rhyolite. Mining concession has expired.

(k) Timah Investasi Mineral (TIM): This covers a wide area outside of the survey area to the east. This is presently at the stage of regional survey.

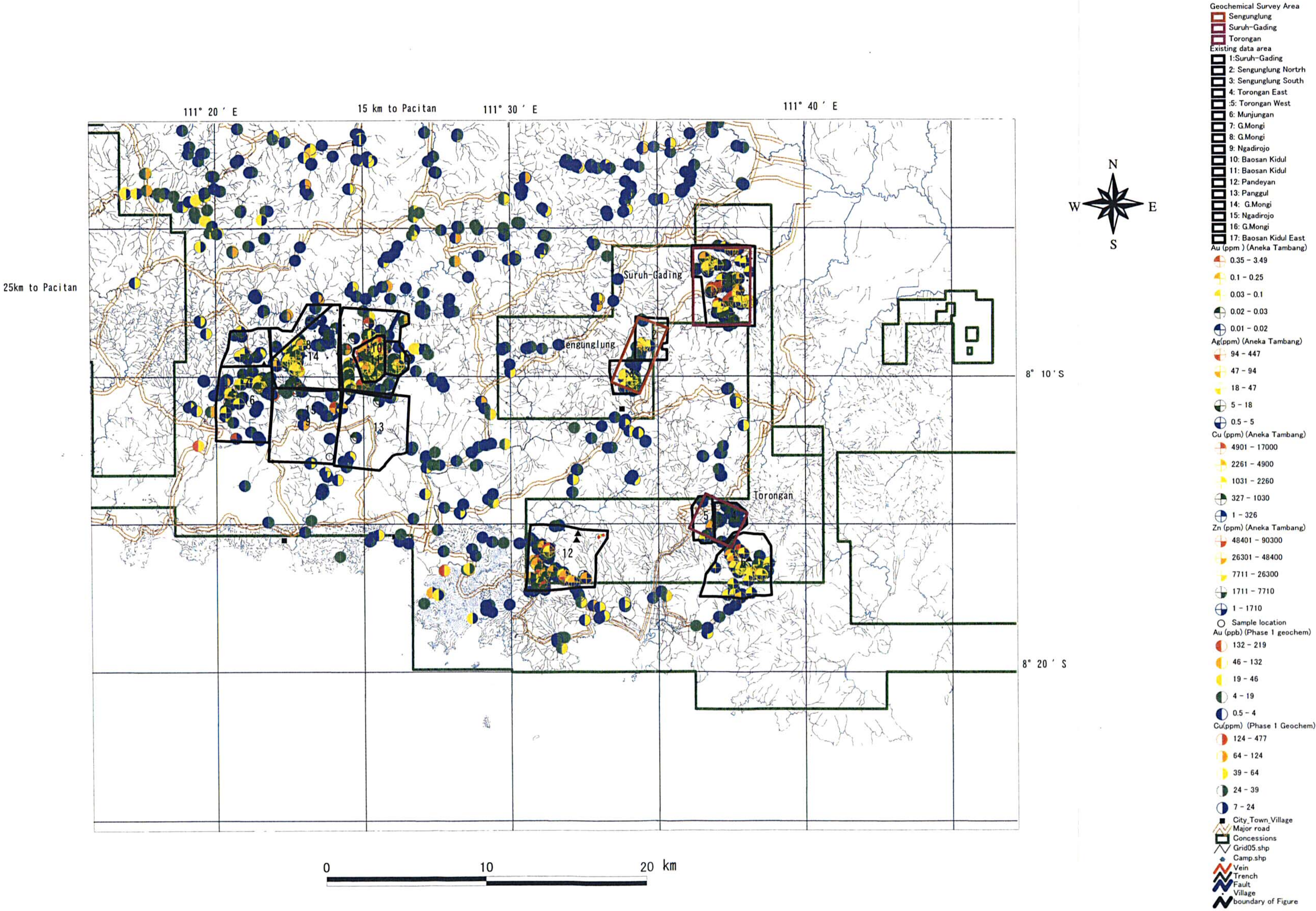


Fig.2-1 Location Map of Mineral Occurrences Based on Existing Data

Chapter 2　Regional Geochemical Survey

Chapter 2　Reginal Geochemical Survey

2 - 1　Method of Survey

An area of 3, 600km^2 was selected for geological survey.　Route maps were prepared based on 1: 25, 000 topographic maps.　Survey routes were set after examination of existing geological data and considering the sampling sites for geochemical survey.　GPS was used for locating the position during the survey. The location of the mineralized zones and exposures were determined by simplified surveying as necessary.　PIMA was used for identifying altered minerals in the field and made efforts to clarify the distribution of the altered minerals and the zoning of alteration zones. The results of the geological survey were, together with existing geological map data and satellite image analysis data, summarized into a 1:100,000 geological map and other material. The processing of collected samples was; rock thin sections 50 samples, ore polished sections 50 samples, X-ray powder refraction analysis 100 samples, ore assay 411 samples, fluid inclusion homogenization temperature and salinity measurement 5 samples, total rock analysis 20 samples, and rock age determination 10 samples.

2 - 2　Outline of Geology

The geology of the survey area consists mainly of Eocene to Pleistocene volcanic rocks and volcaniclastic rocks, and Oligocene-Miocene ~ Pliocene limestone occur from the northwestern to central southern part of the survey area.　Intrusive bodies of dolerite-diorite, porphyry, and quartz porphyry were observed.

2-2-1　Stratigraphy

The basement of Cretaceous System is not exposed in the survey area, but is exposed in Central Java Province.　It is composed of crystalline schist, chert, and basalt and it is believed to be a Cretaceous accretionary zone.

Oligocene-Lower Miocene Series consist predominantly of volcanic and volcaniclastic rocks, and is grouped into 5 divisions.　During the present survey, the past stratigraphic division was essentially used, but based on the results of the survey, the division was simplified by unifying units which cannot be divided by lithofacies-lithology.　In simplifying the geologic units, the geologic structure interpreted from satellite images was considered in changing the boundary of the units.　Namely in the geological map, Oligocene Series-Miocene Series-Pliocene Series were classified as follows, Mandalika Formation (Tomm, Tommt), Watupatok Formation (Tomw, Tomwt), Arjosari Formation (Toma), Sampung Formation (Tmsl), Campurudarat Formation (Tmcl), Semilir Formation (Tms), Wuni Formation (Tmw), Nampol Formation (Tmn), Oyo Formation (Tmo), and Wonosari Formation (Tmwl).

(1) Mandalika Formation (Tomm, Tommt)

Distribution: Distributed widely in the central part.

Composition: Composed of andesitic and basaltic lava and volcaniclastic rocks. Generally massive volcaniclastic rocks without bedding are abundant and stratigraphy and structure is difficult to clarify, but fine-grained volcaniclastics are intercalated in some parts.

Structure: Strike N-S to NE-SW in the northeastern part, and ENE-WSW trending gentle anticline and syncline occur repeatedly southwestward from the northeast. On the other hand, WNW-ESE striking anticline structure occurs in the southwestern part.

Stratigraphy and correlation: The lowermost formation in the survey area and overlies unconformably Cretaceous metamorphic rocks to the northwest of this area. This formation is correlated to Mandalika F., of the Pacitan and Ponorogo Quadrangle sheets, but includes Arjosari F. (Toma) of the Pacitan sheet. Arjosari F., is defined as consisting mainly of conglomerate, sandstone, and siltstone with intercalation of volcaniclastic rocks and lava. But in the survey area, volcaniclastic rocks and lava are possibly dominant, and is difficult to distinguish from Mandalika F. Thus the two units were unified to Tomm. In the Ponorogo sheet, this units is named Panggang F. (Tomp), but is named Mandalika F., in the adjoining Pacitan sheet and thus Panggang F., is included in Mandalika F. Also Dayakan F. (Tomd) consisting of sandstone-mudstone alternation near G. Gembes is also included in Mandalika F.

Thickness: More than 500m.

(2) Watupatok Formation (Tomw, Tomwt)

Distribution: Distributed in the southeastern and western parts.

Composition: This is composed of basalt-andesite similar to Mandalika F., and the unit mainly composed of basalt was separated as Watupatok F. This formation is bedded with intercalation of green tuff and tuffaceous sandstone in the southeastern and western parts, but is generally non-bedded and massive.

Structure: This is harmonious with Mandalika F. It has N-S to NE-SW strike in the northeastern ~ central part of the survey area, while in the western part it shows anticline structure with WNW-ESE strike.

Stratigraphy and correlation: This formation interfingers with Mandalika F. In the southern part, however, it is somewhat lower than Mandalika F. This is generally correlated with the Watupatok

F., in the Ponorogo sheet in the east, but in the west in the Pacitan sheet basalt predominant part of Mandalika F., is treated as Watupatok F.

Thickness: More than 500m.

(3) Arjosari Formation (Toma)

Distribution: This formation is distributed from the southeastern part to the eastern part of the survey area.

Composition: Pyroclastic-dominant part of the basalt-andesite area was named Arjosari F. Andesitic rocks are predominant in this unit similar to Mandalika F. Thin section microscopy, however, showed that this formation is dacitic in the eastern part of the survey area. This formation is generally non-bedded, but green tuff and tuffaceous sandstone is intercalated and is bedded in the central southern and western parts of the area.

Structure: It is harmonious with Mandalika F.

Stratigraphy and correlation: This unit interfingers with Mandalika F. The main part of this formation is somewhat lower stratigraphically than Mandalika F., in the west, but is higher in the eastern part. Thus this perhaps should be treated as independent units in the east and that in the west, but it is presently interpreted as interfingering relation. This formation is, on the whole, correlated to the Arjosari F., of the Pacitan sheet in the west and to Watupatok F., of the Ponorogo sheet in the east, but parts of the Arjosari F., of the Pacitan sheet were described as Mandalika F.

Thickness: More than 150m.

(4) Semilir Formation (Tms)

Distribution: This formation is distributed from the northern to the western part of the survey area.

Composition: This consists of tuff and sandstone-mudstone alternation. Nature of tuff varies considerably, namely dacitic, andesitic, to basaltic. Bedding is generally clear.

Stratigraphy and correlation: The lower part of this units interfingers with Panggang F., Dayakan F., and Watupatok F., while the upper part is transitional to Nglanggran F. In the south this is correlated to upper part of Ajossari F., and is considered to be Upper Miocene Series.

Thickness: More than 750m.

(5) Sampung Formation (Tmsl)

Distribution: This occurs in a small zone in the northern part of the survey area.

Composition: This is composed of calcareous sandstone, marl, and limestone, and partly of conglomerate. This is shallow marine sediment.

Stratigraphy: This overlies Mandalika F.

(6) Campurdarat Formation (Tmcl)

Distribution: This occurs in a small zone in the eastern part of the survey area.

Composition: This unit consists of limestone and mudstone.

(7) Wuni Formation (Tmw)

Distribution: This formation is distributed in a narrow E-W trending zone in the northwest and southwest parts of the survey area.

Composition: This unit is composed of dacitic to andesitic volcaniclastic rocks. The volcaniclastic material contains green tuffaceous sandstone.

Stratigraphy and correlation: This interfingers with the lower Jaten F., and as volcaniclastic rocks are dominant in Jaten F., area in the Pacitan sheet, Jaten F., was included in this formation. This is stratigraphically above Campurdarat F., and Sampung F. It is believed to belong to the Upper Miocene Series.

Thickness: 500m

Distribution: Distributed widely in the central part.

Composition: Composed of andesitic and basaltic lava and volcaniclastic rocks. Generally massive volcaniclastic rocks without bedding are abundant and stratigraphy and structure is difficult to clarify, but fine-grained volcaniclastics are intercalated in some parts.

Structure: Strike N-S to NE-SW in the northeastern part, and ENE-WSW trending gentle anticline and syncline occur repeatedly southwestward from the northeast. On the other hand, WNW-ESE striking anticline structure occurs in the southwestern part.

Stratigraphy and correlation: The lowermost formation in the survey area and overlies unconformably Cretaceous metamorphic rocks to the northwest of this area. This formation is correlated to Mandalika F., of the Pacitan and Ponorogo Quadrangle sheets, but includes the Arjosari F., (Toma) of the Pacitan sheet. The Arjosari F., is defined as consisting mainly of conglomerate, sandstone, and siltstone with intercalation of volcaniclastic rocks and lava. But in the survey area, volcaniclastic rocks and lava are possibly dominant, and is difficult to distinguish from Mandalika F. Thus the two nits were unified to Tomm. In the Ponoigoro sheet, this units is named Panggang F., (Tomp), but is named Mandalika F., in the adjoining Pacitan sheet and thus Panggang F., is included in Mandalika F. Also Dayakan F., (Tomd) consisting of sandstone-mudstone alternation near G. Gembes is also included in Mandalika F.

Thickness: More than 500m.

(8) Watupatok Formation (Tomw, Tomwt)

Distribution: Distributed in the southeastern and western parts.

Composition: This is composed of basalt-andesite similar to Mandalika F., and the unit mainly composed of basalt was separated as Watupatok F. This formation is bedded with intercalation of green tuff and tuffaceous sandstone in the southeastern and western parts, but is generally non-bedded and massive.

Structure: This is harmonious with Mandalika F. It has N-S to NE-SW strike in the northeastern ~ central part of the survey area, while in the western part it shows anticline structure with WNW-ESE strike.

Stratigraphy and correlation: This formation interfingers with Mandalika F. In the southern part, however, it is somewhat lower than Mandalika F. This is generally correlated with the Watupatok F., in the Ponorogo sheet in the east, but in the west in the Pacitan sheet basalt predominant part of Mandalika F., is treated as Watupatok F.

Thickness: More than 500m.

(9) Arjosari Formation (Toma)

Distribution: This formation is distributed from the southeastern part to the eastern part of the survey area.
Composition: Pyroclastic-dominant part of the basalt-andesite area was named Arjosari F. Andesitic rocks are predominant in this unit similar to Mandalika F. Thin section microscopy, however, showed that this formation is dacitic in the eastern part of the survey area. This formation is generally non-bedded, but green tuff and tuffaceous sandstone is intercalated and is bedded in the central southern and western parts of the area.
Structure: It is harmonious with Mandalika F.
Stratigraphy and correlation: This unit interfingers with Mandalika F. The main part of this formation is somewhat lower stratigraphically than Mandalika F., in the west, but is higher in the eastern part. Thus this perhaps should be treated as independent units in the east and that in the west, but it is presently interpreted as interfingering relation. This formation is, on the whole, correlated to the Arjosari F., of the Pacitan sheet in the west and to the Watupatok F., of the Ponorogo sheet in the east, but parts of the Arjosari F., of the Pacitan F., was described as Mandalika F.
Thickness: More than 150m.

(10) Semilir Formation (Tms)
Distribution: This formation is distributed from the northern to the western part of the survey area.
Composition: This consists of tuff and sandstone-mudstone alternation. Nature of tuff varies considerably, namely dacitic, andesitic, to basaltic. Bedding is generally clear.
Stratigraphy and correlation: The lower part of this units interfingers with Panggang F., Dayakan F., and Watupatok F., while the upper part is transitional to the Nglanggran F. In the south this is correlated to upper part of the Arjosari F., and is considered to be Upper Miocene Series.
Thickness: More than 750m.

(11) Sampung Formation (Tmsl)
Distribution: This occurs in a small zone in the northern part of the survey area.
Composition: This is composed of calcareous sandstone, marl, and limestone, and partly of conglomerate. This is shallow marine sediment.
Stratigraphy: This overlies Mandalika F.

(12) Campurdarat Formation (Tmcl)
Distribution: This occurs in a small zone in the eastern part of the survey area.
Composition: This unit consists of limestone and mudstone.

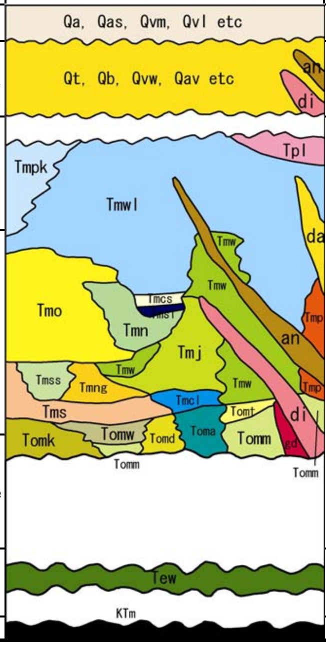
(13) Wuni Formation (Tmw)

Distribution: This formation is distributed in a narrow E-W trending zone in the northwest and southwest parts of the survey area.

Composition: This unit is composed of dacitic to andesitic volcaniclastic rocks. The volcaniclastic material contains green tuffaceous sandstone.

Stratigraphy and correlation: This interfingers with the lower Jaten F., and as volcaniclastic rocks are dominant in the Jaten F., area in the Pacitan sheet, Jaten F., was included in this formation. This is stratigraphically above the Campurdarat F., and Sampung F. It is believed to belong to the Upper Miocene Series.

Thickness: 500m



Age		Formation (rock facies)	Intrusive rocks
Quaternary	Holocene	Qa, Qaf, Qal: Alluvium (gravel, sand, mud), Qvm, Qvl(Qlla), Qd, Qhvp, Qvk, Qvlh, Qv(n,p), Qvtm(Qptm), Qvtr, Qvs, Qvb, Qtt, Qvaw, Qvt, Qlv, Qlks, Qls, Qvll: volcanic rocks, Qpk, Qas, Ql, Qc: sedimentary rocks, Qt: terrace deposits	
	Pleistocene	Qt: Alluvium (gravel, sand, mud), Qb, Qpk, Qpp, Qpw: sedimentary rocks Qvw(Qjt), Qvjt, Qvjl, Qvsl, Qvjb, Qvbl, Qvbt, Qas, Qav, Qpg, Qp, Qjd, Qj, Qjk, Qjt, Qjn, Qav(Qpwv), Qpvp, Qpvk, Qpva, Qpat, Qpkb, Qptm, Qlk, Qpv(kb,t,b), Qp(g–j–a), Qpvb, Qpkb, Qvk, Qvt, Qvj, Qpvt, Qvp, Qvl: volcanic rocks	Qi(g, b, a): gabbro, basalt, andesite Qpp, Qppr: andesite Tpdi: diorite
Neogene	Pliocene	Tmpk: Kepek Formation (limestone) Tpl: Leprak Formation (sandstone, mudstone, marl, limestone) Tmwl: Wonosari Formation (limestone)	
	Miocene	Tmw: Wuni Formation (volcaniclastics, sandstone, mudstone, imestone) Tmo: Oyo Formation (sandstone, mudstone) Tmj: Jaten Formation (sandstone, mudstone, limestone) Tmn: Nampol Formation (tuffaceous sandstone, mudstone, limestone) Tmp: Puger Formation (limestone, sandstone) Tmcs: Angotta member (Sampung Formation; calcareous sandstone, sandstone) Tmsl: Sampung Formation (marl, limestone) Tmss: Sambipitu Formation (sandstone, mudstone) Tms: Semilir Formation (tuff, tuffaceous sandstone), Tmng: Nglanggran Formation (andesite, basalt lava, volcaniclastics) Tomk: Kebobutak Formation (conglomerate, sandstone, volcaniclastics), Tomt: Mandalika Formation (tuff, tuff breccia)	Tmid: diorite (porphyry) Tm (a, d, b): andesite dacite dolerite Tomi (a, an, d, da, b, di, t, gd): andesite
Paleogene	Oligocene	Tmcl: Campurdarat Formation (limestone, mudstone) Tomd: Dayakan Formation (sandstone, mudstone) Tomw: Watupatok Formation (basalt, andesite lava, volcaniclastics) Toma: Arjosari Formation (conglomerate, sandstone, volcaniclastics) Tomm: Mandalika Formation (andesite, basalt lava, volcaniclastics), Tomp:Panggang Formation (andesite, basalt lava, volcaniclastics)	dacite dolerite diorite tonalite granodiorite
	Eocene	Tew: Gamping Wungkal Formation (sandstone, mudstone, marl)	
Cretaceous		KTm: metamorphic rocks (schist, metavolcanics)	

Fig. 3-1 Schematic Geologic Column of the Survey Area

Table 3-1 Correlation of Geologic Units

		1408-3 SURAKARTA	1508-1 PONOROGO	1507-4 PACITAN	1508-2 MADIUN	1507-5 TULUNGAUNG	1508-3 KEDIRI	1507-6 BLITAR	1608-1 MALANG	1607-4 TUREN	1608-2 PROBOLINGGO	1607-5 LUMAJANG
Qa	Alluvium & Quarternary deposits	Qa Alluvium	Qa Alluvium Qaf Alluvium, Fan Deposits	Qa Alluvium	Qa Alluvium	Qa Alluvium	Qa Alluvium Qt Terrace Deposits	Qa Alluvium	Qa Alluvium Qt Terrace Deposits	Qal Alluvium and Coastal deposits Qas Swampand River Deposits	Qa Alluvium	Qa Alluvium Qc Coastal Deposits
Ql	Quarternary limestone										Ql Coral Limestome	
Qs	Pleistocene Sedimenatary Rocks	Qb Baturetno Formation Qt Older Alluvium		Qpk Kalipucang Formation	Qpnv Notopuro Formation Qpk Kabuh Formation		Qpnv Notopuro Formation Qpk Kabuh Formation Qpp Pucangan Formation		Qpw Welang Formation Qpj Jambang Formation Qpk Kabuh Formation			
Qhv	Quarternary (Holocene) volcanics	Qvm Merapi Volcanic Rocks Qvl Lawu Volcanic Rocks	Qlla Lawu Lahar Qvcl Condrodimuko Lava Qval Anak Lava Qvl Lawu Volcanics				Qd Kelud Debris Qvlh Laharic Deposits Qvk Young Kelud Volcanics Qv(n,p) Upper Quarternary Volcanics Qhvp Young Parasitic Volcanics	Qvlh Laharic Deposits Qvk Kelud Volcanics Qptm Tuff	Qvs Tengger Volcanic Sands Qvb Bromo Volcanics Qtt Cemaratiga Debris Qv(n,p) Upper Quaternary Volcanics Qvtm Malang Tuff	Qlv Avalanche deposits Qlks Lava Qls Lava Qlk Lava Qptm Tuff Qpvb Volcanics Qvs Volcanics Qvk Volcanics	Qvl Lamangan Volcanic Rocks Qvll Lamangan Lava Qtt Cemeratiga Debris	Qlks Lava Qls Lava Qvs Semeru Volcanic Rocks Qvk Karangduren Volcanic Dune
Qpv	Quarternary (Pleistocene) volcanics		Qvw Wilis Volcanics Qvjl Jobolarangan Lava Qvsl Sidoramping Lava Qvjb Jobolarangan Breccia Qvtt Tambal Tuff Qvbl Butak Lava Qvbt Butak Tuff Qvjt Jobolangan Tuff		Qav Argokalangan Morphocet Qas Sedudo Morphonit Qp Pawonsewu Morphonit Qpg Gajahmungkur Morphonit Qj Patukbanteng-jeding Morphocet Qjt Tanjungsari Morphonit Qjn Ngebel Morphonit Qjd Dangean Morphonit Qjk Klotok Morphonit	Qpwv Wilis Volcanic Rocks	Qpvp Old Parasitic Volcanics Qpkb Kawa-Butak Volcanics Qpva Young Anjasmara Volcanics Qpat Old anjasmara Volcanics Qpvk Old Kelud Volcanics	Opvk Old Kelud Volcanics Qlk Parasite Andesitic Lava Qpkb Butak Volcanics	Qvtr Rabano Tuff Qvt Tengger Volcanics Qvaw Arjuna-Welirang Volcanics Qpv Middle Quaternary Volcanics Qp Lower Quaternary Volcanics Qpat Old Anjasmara Volcanics	Qvt Volcanics Qvj Volcanics Qpkb Lava	Qvt Tengger Volcanic Rocks Qva Argoporo Volcanic Rocks Qpvt Old Tengger Volcanic Rocks Qvp Pandak Volcanic Rocks Qvtr Rabano Tuff	Qvt Tengger Vocanic Rocks Qvj Jembangan Volcanic Rocks Qvl Lamongan Volcanic Rocks Qvab Argopuro Breccia Qvat Argopuro Tuff
Qi	Quarternary intrusives				Qppr Parang Andesite Intrusive Qpp Punjul Andesite Intrusive							
Tns	Neogene (Miocene-Pliocene) sediments	Tmo Oyo Formation		Tmo Oyo Formation								
Tms	Miocene sediments	Tmn Nampol Formation Tmss Sambipitu Formation Tmj Jaten Formation	Tmcs Cendono Formation	Tmn Nampol Formation Tmj Jaten Formation	Tmj Jaten Formation	Tmn Nampol Formation Tmj Jaten Formation		Tmn Nampol Formation		Tmn Nampol Formation		
Tnl	Neogene (Miocene-Pliocene) limestones	Tmpk Kepek Formation Tmwl Wonosari Formation	Tmwl Wonosari Formation	Tmwl Wonosari Formation	Tmwl Wonosari Formation	Tmwl Wonosari Formation		Tmwl Wonosari Formation		Tmwl Wonosari Formation	Tpl Leprak Formation	
Tml	Miocene limestones		Tmal Sampung Formation	Tmcl Campurdarat Formation		Tmcl Campurdarat Formation		Tmcl Campurdarat Formation				Tmp Puger Formation
Tmv	Miocene volcanics	Tmng Nglanggran Formation Tmw Wumi Formation Tms Semilir Formation	Tmn Nglanggran Formation Tms Semilir Formation	Tmw Wuni Formation Tms Semilir Formation	Tmw Wuni Formation	Tmw Wuni Formation		Tmw Wuni Formation		Tmw Wuni Formation		
Tni	Neogene intrusives	Tpdi Pendul Diorite	Tm (a b d) Intrusive Rocks	Tomi Intrusive Rocks	Tomi Intrusive Rocks	Tomi Intrusive Rocks		Tomi Intrusive Rocks		Tomi Intrusive Rocks		Tmid Intrusive Rocks
Toms	Oligocene-Miocene sediments	Tomk Kebobutak Formation	Tomd Dayakan Formation	Toma Arjosari Formation		Toma Arjosari Formation						
Tomv	Oligocene-Miocene volcanics	Tomm Mandalika Formation	Tomw Watupatok Formation Tomp Panggang Formation	Tomw Watupatok Formation Tomm Mandalika Formation	Tomm Mandalika Formation	Tomm Mandalika Formation		Tomt Tuff member of Mandalika Formation Tomm Mandalika Formation		Tomt Tuff member of Mandalika Formation Tomm Mandalika Formation		Tomm Mandalika Formation
Tps	Paleogene sediments	Tew Gamping Wungkal Formation										
pTm	Pre-Tertinary rocks	KTm Metamorphic Rocks										

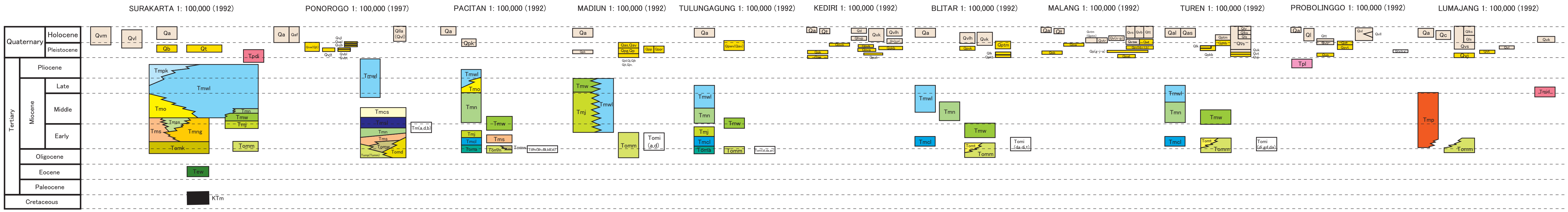


Fig. 3-2 Geologic Correlation of the Survey Area

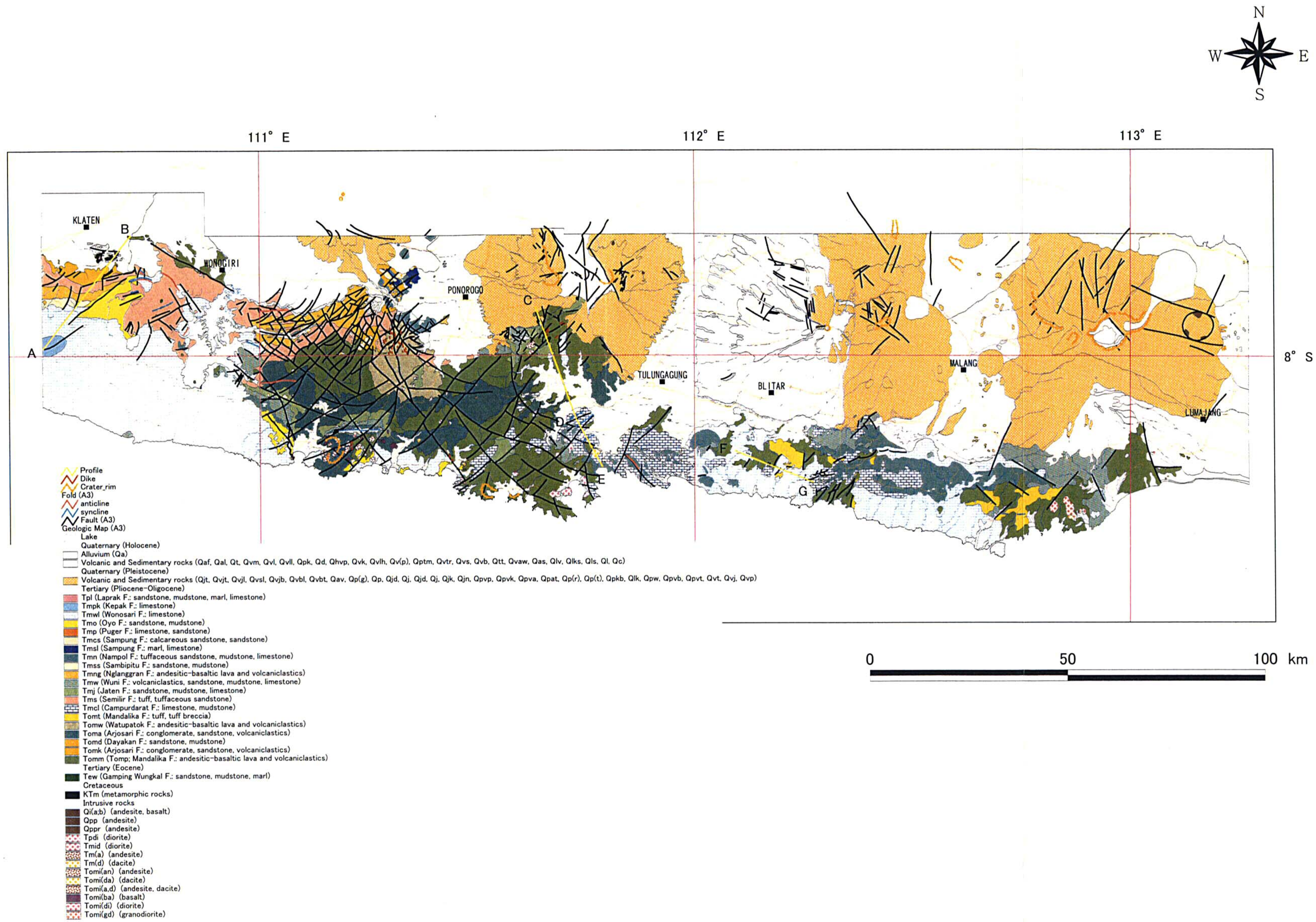


Fig. 3-3 Geologic Map (1/ 1,000,000)

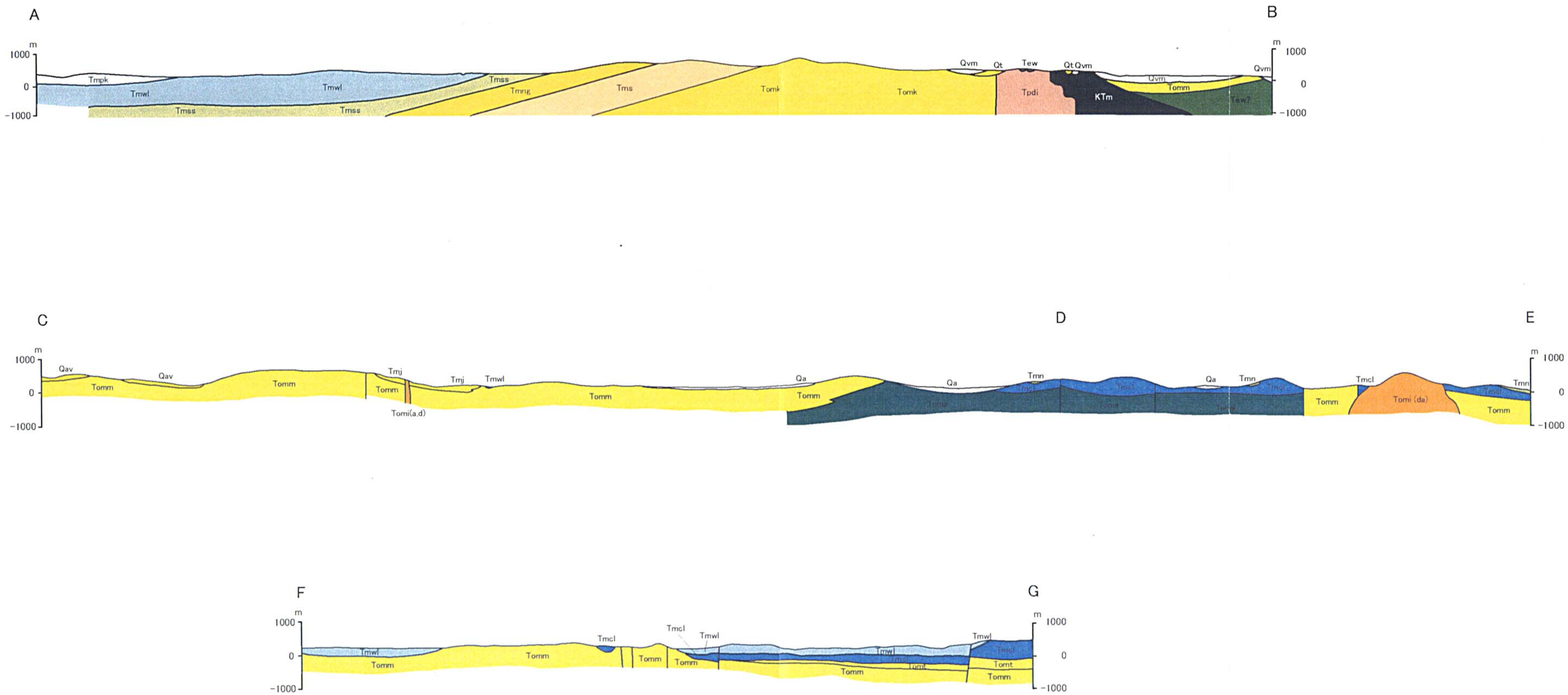


Fig. 3-4 Geologic Profiles of the Survey Area

(14) Nampol Formation (Tmm)

Distribution: This is distributed in the northwestern part of the survey area,

Composition: This unit is composed of tuffaceous sandstone, siltstone with intercalation of conglomerate and limestone.

Structure: Similar to the Wuni F., gently dipping and gently curving in the E-W direction.

Stratigraphy and correlation: Main part of this unit overlies and partly interfingers with Wuni F., and underlies the Wonosari F. It is believed to be Upper Miocene unit.

Thickness: 200m.

(15) Wonosari Formation (Tmwl)

Distribution: Mainly in the coastal zones.

Composition: This consists mainly of reefal limestone and calcareous limestone with intercalation of conglomerate and marl. It is correlated to upper Miocene to Pliocene Series. It is in structural contact with andesite, but has not been metamorphosed.

Stratigraphy: The main part of this unit is considered to be Pliocene.

(16) Quaternary volcanic rocks

This unit is distributed in the northern part of the survey area, and consists mainly of andesitic lava and volcaniclastic rocks. In the Ponorogo sheet, the quaternary volcanics are divided into 12 units with total thickness of more than 2, 000m. Quaternary units are not the object of the present survey and thus they are treated as one in the geological map. Those overlying the Tertiary units, which are the concern of this survey, are called Lahar, and are mixed deposits of basalt, andesite and pumice, and volcanic ash.

(17) Quaternary System-Alluvium:

These occur mainly near Ponorogo and Wonogir, and along the rivers in the southern part. They consist of gravel, sand, and mud.

2-2-2 Intrusive Rocks

Basalt, diorite, porphyry, andesite, dacite-quartz porphyry are the major intrusive rocks of the survey area. Fine-grained basalt-diorite and dacite-quartz porphyry are generally metamorphosed. The age of the intrusive rocks are; 17.8 Ma for diorite, 21.7-19.7 Ma for andesitic rocks in the western

part, 23.7-14.6Ma for andesite in the eastern part, and 10.1 Ma for dacite in the eastern part.
The important results of microscopic study are as follows.

Dolerite: This has holocrystalline porphyritic texture, phenocrysts are coarse-grained subhedral to euhedral plagioclase and subhedral altered mafic minerals, and the matrix has intersertal texture and consists of medium-grained subhedral plagioclase and clinopyroxene (anhedral and grainy), and opaque minerals. Alteration is strong and is sericitized, and calcitization, silicification, epidotization, albitizaton are observed for plagioclase phenocrysts, and mafic minerals (clinopyroxene?) are characterized by epidotization and chloritization. Secondary epidote and calcite occur in parts of matrix.

Diorite: This is a plutonic rock with holocrystalline equigranular texture and is composed mainly of subhedral prismatic plagioclase, prismatic clinopyroxene, and amphibole, and other granular opaque minerals. Many mafic minerals are generally chloritized, but relatively fresh clinopyroxene occur occasionally and the altered minerals are possibly amphiboles. Zoning of plagioclase is weak and is homogeneous. Amphiboles are hornblende and also actinolite occurs which may be altered mineral.

Dacite-quartz porphyry: Primary quartz phenocrysts (anhedral by corrosion), and small amount of plagioclase phenocrysts are observed. The rock is, as a whole, weakly sericitized. Mosaic quartz is dominant in the matrix and small amount of sericite is observed among the interstices. Pool aggregates of coarse mosaic quartz and vein quartz are developed in this rocks. The periphery of quartz phenocrysts is surrounded by secondary fine to micro-grained quartz. Also small amounts of chlorite and smectite are observed.

2-2-3 Geologic Structure

The geologic structure of the western part is characterized by faults of the NE-SW and NW-SE systems and homocline structure striking in the ENE-WSW direction with southward dip. Although exposures where attitude of the units can be measured are limited and the geologic structure is not clear, but it is seen that in the western part of the survey area, pre-Tertiary System occurs in the north which is overlain by younger Tertiary System southward. Regionally, western to central Java consists of Cretaceous accretionary zone, while eastern Java is believed to be Cenozoic accretionary zone. The boundary of the two zones is considered to extend in the ENE-WSW direction in the western area and this does not contradict the structure laid out above. Most probably this region was under N-S compressional stress after the Tertiary period.

The geology of the eastern area is characterized by faults of the NE-SW and NW-SE systems. The distribution of the faults, however, is dense in the western margin but is sparse from the central to the eastern part.

On the other hand, quartz veins associated with old, silver, copper, lead, and zinc mineralization are predominantly N-S trending in both Selogiri in the western area and Prambon and Seweden in the eastern area. Therefore, as with the hypothesis tabled during the first year, these quartz veins are interpreted to have formed in the tensional fissures formed in regional N-S compressional field. It is also noted that there are alteration zones which are inferred to extend in the N-S direction more or less parallel to the direction of the ore veins.

2-2-4 Mineralization and Alteration

Gold, silver, copper, lead, and zinc mineralization is observed in the second-year area for regional geochemical survey. Also manganese mineralization was observed, but it was of smaller scale. The gold, silver, copper, lead, and zinc mineralization was mainly found in chalcopyrite-galena-sphalerite-bearing quartz veins. Skarn minerals occur in existing mining concession area and associated base-metal mineralization is inferred to occur. Results of geochemical survey showed geochemical anomalies of gold, silver, copper, lead, and zinc.

Major mineralized zones of the survey area are concluded to occur at the following districts.

(a) Selogiri district: Selogiri deposit in the eastern margin of the western area and auriferous quartz veins in the vicinity.

(b) Prambon district: Quartz veins (gold, silver anomalies) to the north of Trenggalek in the southwestern part of the eastern area of the district.

(c) Sentul East district: Silicified zones to the southwest of Trenggalek.

(d) Seweden district: Alteration zones associated with gold, copper mineralization to the south of Blitar in the central part of eastern area of the district.

(e) Purwodadi district: Copper, gold mineralized and altered zones to the southeast of Malang.

(f) Tempursari district: Gold, copper mineralized and altered zones.

(g) K. Jinggring district: Gold anomalous zones to the south of Tulungagung in the western part of the eastern area.

(h) Geochemical anomalies, quartz veinlets, alteration zones near the Royal Indo Tama concession

(i) Purwoharjo district: Copper anomaly zone continuing northeastward from this district.

The mineralized geologic units are mostly Oligocene to Miocene volcanic and volcaniclastic rocks and gold, silver, copper, lead, zinc mineralization-alteration are not confirmed in the Quaternary System. Diorite porphyry bodies have intruded into andesite of similar nature near the Selogiri Deposit in the western part. On the other hand, many intrusive bodies are observed such as diorite-quartz diorite, basalt, dacite and others. In the Seweden District dacite occurs closely associated with hydrothermal alteration zones, and caused recrystallization of Middle Miocene to Pliocene limestone in the vicinity. Thus the mineralization is considered to have occurred from Middle Miocene to Pliocene. Also the age of granodiorite exposed near Purwodadi is 17.8Ma、namely Miocene.

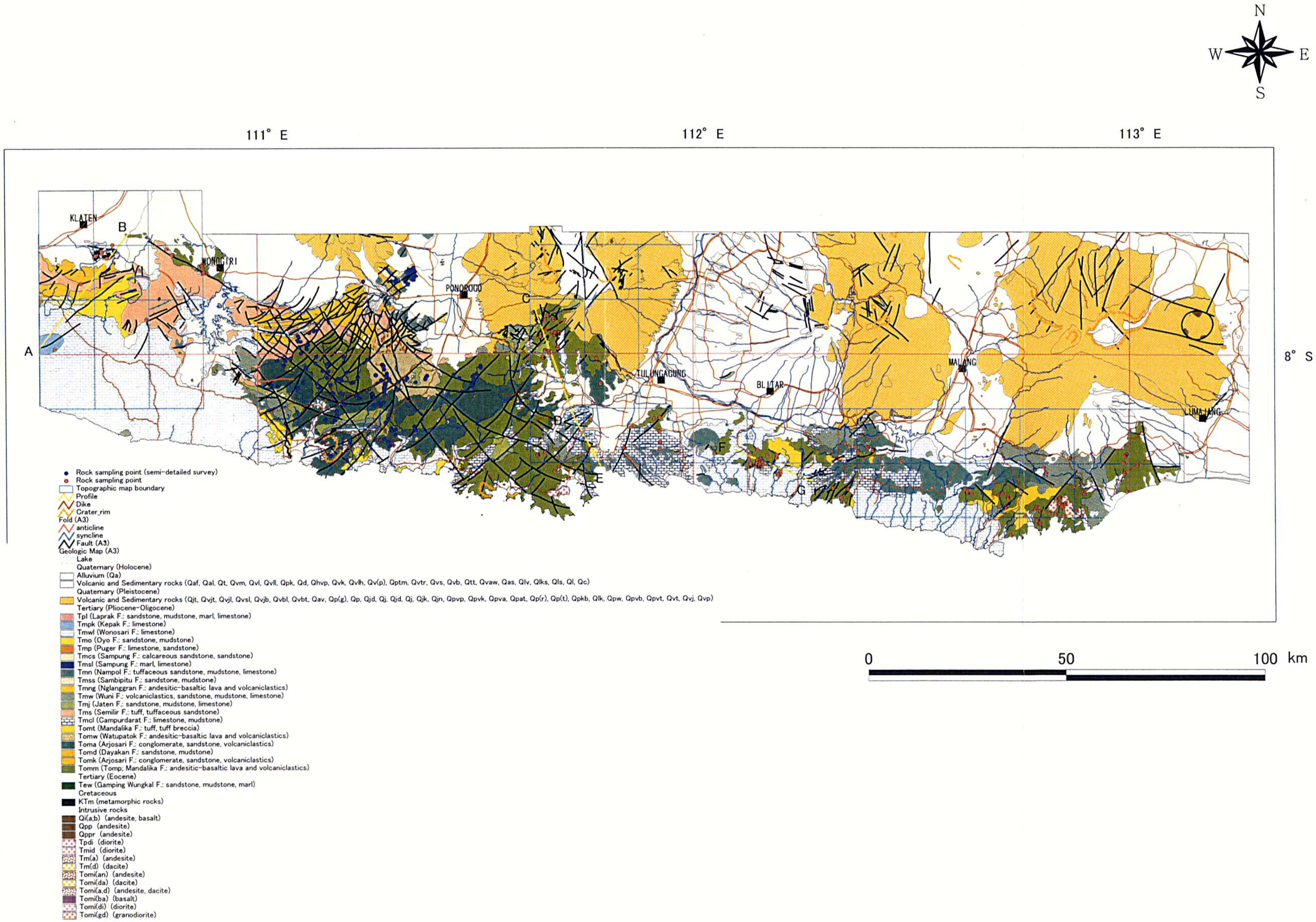


Fig. 3-5 Location Map of Rock Samples

Table 3-2 Results of Microscopic Observation of Thin Sections

Sample No.	Rock name (field name)	Rock name	Texture	Phenocryst /groundmass											Matrix/Fragments		Alteration Mineral										
				ol	cpx	opx	pl	op	hb	bio	kf	qz	zr	ap	glass	Lithic fragment	qz	leu	ser	kao	chl	cal	sm	ep	zeo	pl	pre
G002	tuff	Hornblende andesite	porphyritic				◎	・	△			○	×	×			○					・	・	・			
G003	welded tuff?	Altered hornblende andesite	porphyritic				○	・	△			△		×			○				△	○	・				
G005	andesite	Andesite	porphyritic		・	○	◎	・	・						・								○				
G008	basalt-andesite	Andesitic	porphyritic			△	◎	・	・						△				△				○	×			
G014	quartz porphyry ?	Altered andesite	porphyritic				○	×	・										chl/sm？・				○				
G021	quartz porphyry ?	Altered dacite-andesite	porphyritic				◎	・	・			○					△		chl/sm？・					・			
G033	andesitic volcanic breccia	Psammitic schist	schistose				◎	・		×		○		×		sphene:×			muscovite:○								
G045	welded tuff?	Andesite	porphyritic		○		◎	×							△?								・?				
G051	coarse grained andesite	Altered andesite-dacite	porphyritic				◎	・	△			△		×							・	・		×			
G064	quartz	Altered andesite	porphyritic		△	・?	○	・	・?										chl/sm			・	・	×			
G095	microdiorite	Andesite	porphyritic		△		○	・						×								・	・				
G125		Diorite	holocrystalline				◎	・	○			△	×	×							・	・		・			
G146	basalt	Dacite (quartz porphyry)	porphyritic, holocrystalline				○	・	△			○									chl/sm？・		・				
G147	andesite (propylite)	Altered dacite	porphyritic, holocrystalline				○	・	・?			△		×					chl/sm？・		・		×			albite:・	
G156	porphyry	Dacite (quartz porphyry)	porphyritic, holocrystalline				○	×	・			△		×					・		・		・				
G165	basalt; dark grey to green	Andesite	porphyritic,amygdaloidal		△		◎	・						×					chl/sm？・				・				
G166	dacitic Lapilli tuff containing much chlorite	Dacitic tuff	tuffaceous texture				△	・				○										△		・			
G170	basalt; black typical	Andesite	aphyric				○	・							△				chl/sm？・				・?				
H002	fine tuff; pale grey, alternated bed with coarse tuff	Andesite porphyry	porphyritic, holocrystalline		○		◎	・															・				
H019	dacite; grey (dike)	Altered andesite	subequigranular		・	・	◎	×											chl/sm？・			・		・			
H022	basaltic fine tuff; grey to green, with coarse tuff	Altered andesite	porphyritic		・	△	◎	×									・					・	・				
H028	porphyritic hornblende andesite; pale greenish grey	Altered andesite	porphyritic, holocrystalline				◎	×									△		・		△	・	・				
H030	hornblende dacite; grey (intrusive rock)	Altered andesite	porphyritic,amygdaloidal		○		◎	・									△		・		chl/sm・	×	・				
H033	altered (silicified) hornblend andesite; grey, py-ser	Andesite-basaltic andesite	porphyritic, holocrystalline		△	・	◎	×				・											×		×?		
H035	porphyritic andesite; grey, host rock of quartz-py vein	Andesite-basaltic andesite	porphyritic, holocrystalline		△	△	◎	・				・?									chl/sm？・		・	・	×?		
H057	diorite; dark green, host rock of quartz-py veins	Basalt	aphyric				◎	・														・	・				
H061	float of silicified dacite (?)	Altered Dacite	porphyritic, holocrystalline				△					△					◎		ser/sm・								
H087	grey dacite	Altered andesite	porphyritic		・		◎	・											chl/sm・			・	・		・		
H090	andesite	Pumice tuff	tuffaceous texture				△	×				△			・	pumice:△	chalcedonic:△						×		×?		
H091	pale green patch andesite	Basalt	aphyric		△		◎	×									・		chl/sm？・			・	・		×		
H092	pale-green andesite origin of C17	Silicifed dacitic tuff	tuffaceous texture				○	・				△					・						×			albite:○	
H093	basalt	Basalt	aphyric, amygdaloidal				△										△?					・	・				
H094	basaltic tuff breccia	Andesite	sub-porphyritic		○		○	×			・				△				chl/sm？・				・				
I003	andesitic to basaltic lapilli tuff	Hornblende andesite	porphyritic		・		◎	・	△						○												
I004	pale green andesite	Two pyroxene andesite	porphyritic		・	×	◎	・							△				sm/chl・			・	・				
I020	andesite	Meta-granodiorite	equigranular				◎	・	○		・	・	×	×					chl/sm？・		actinolite?・						
I041	andesite	Obsidian	glassy-aphanitic		・		△	・				chalcedonic・			◎												
I077	acidic tuff	Porphyritic andesite	sub-porphyritic		△		○	・	・?												biotite?chl/sm・						
I078	dolerite	Silicifed andesite	porphyritic, holocrystalline				◎	×						×			◎				・	・	・				
J047	basalt lava?	Altered andesitic tuff	tuffaceous texture		△?		△	・											chl/sm？・		・	・	・	・			
J053	andesite	Altered granite	equigranular				○	・		・?	△	◎	×	×			・		・		△	・	△	△			
K020	dolerite	Augite andesite	porphyritic		○		◎	・							△												
K047	fine diorite	Altered dacite	porphyritic				○	・	△?			○					・		・		・	・	・	・			
K048	rhyolitic tuff breccia	Dacite	porphyritic, holocrystalline				○	・				△					◎		chl/sm？・			○				albite:○	
K068	welded tuff (dacitic?)	Dacitic-andesitic tuff	porphyritic				◎	・				・					△		chl/sm？・					・			
L004	welded tuff (dacitic?)	Andesite	porphyritic		△		◎	・	×	×					△				chl/sm？・								
L028	Quaternary volcanics	Basaltic andesite	porphyritic, holocrystalline	△?			◎	×							○				chl/sm？・			・					
L029	host rock of quartz vein (basalt)	Altered dacite	porphyritic				○	×				△			・		○		chl/sm？・			△		・			
L033	host rock of quartz vein (lapilli tuff)	Altered dacite	porphyritic				○					△					◎		△								
L045	basalt	Basaltic andesite	porphyritic, holocrystalline		△	・	◎	・											chl/sm？・				・				

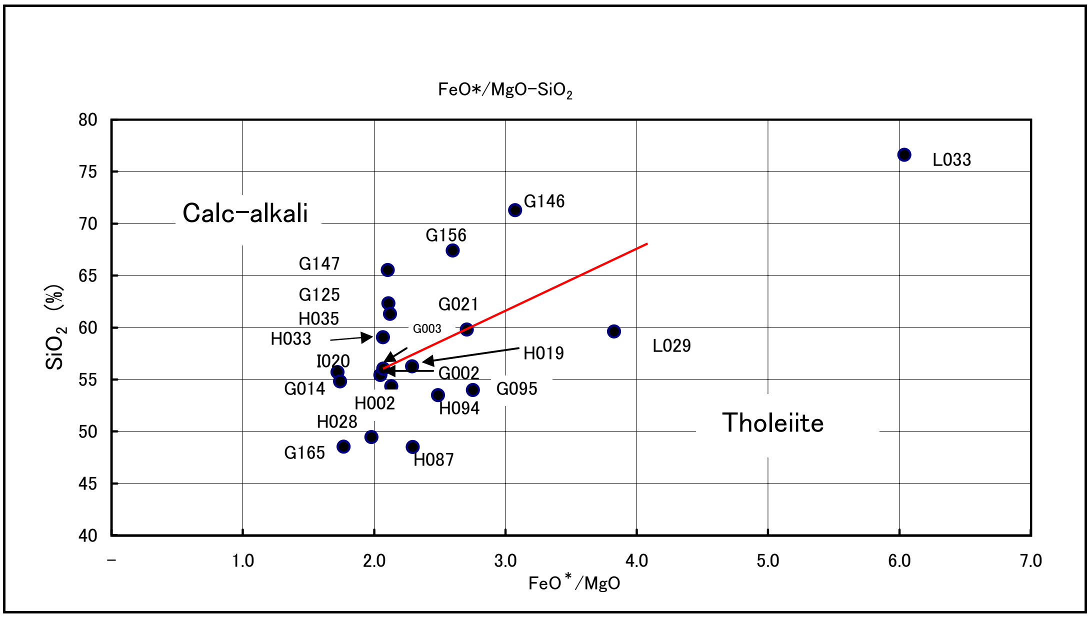
ol:olivine, cpx:clino-pyroxene, opx:ortho-pyroxene, op:opaque mineral, hb:hornblende, bio:biotite
kf:potash-feldspar, qz:quartz, zr:zircon, ap:apatite, frag:fragment,leu:leucoxene, ser:sericite, kao:kaolin, cal:calcite, sm:smectite, ep:epidote
chl:chlorite, zeo:zeolite, pl:plagioclase, pre:prehnite, ill: illite, zr: zircon

Table 3-3 Results of Whole Rock Analysis

Element	UTM (N)	UTM (E)	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	Cr2O3	SrO	BaO	LOI	Sum
Analysis Unit			%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Detection Limit			0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01
G002W	9,136,354	484,798	55.68	17.47	7.24	3.60	3.56	0.72	6.89	0.12	0.57	0.11	<0.01	0.03	0.03	3.04	99.07
G003W	9,135,796	485,977	55.39	17.38	7.79	2.94	3.22	0.71	6.70	0.13	0.60	0.14	0.01	0.03	0.03	4.81	99.89
G014W	9,138,588	479,870	54.78	17.12	8.08	4.07	2.70	1.14	7.89	0.15	0.73	0.16	0.03	0.03	0.02	2.74	99.66
G021W	9,136,075	486,275	59.76	16.55	6.10	1.88	3.65	0.95	5.66	0.18	0.48	0.19	0.01	0.04	0.03	4.48	99.94
G095W	9,081,820	645,639	53.96	17.08	8.47	3.26	2.88	0.42	9.98	0.21	1.00	0.14	0.01	0.02	0.01	1.78	99.22
G125W	9,077,582	704,298	62.29	15.00	5.66	2.94	3.55	0.31	6.90	0.09	0.60	0.07	0.01	0.02	<0.01	2.11	99.54
G146W	9,073,940	707,233	71.26	13.06	2.58	1.17	3.71	1.14	4.00	0.05	0.40	0.08	0.01	0.01	0.01	2.07	99.54
G147W	9,074,360	706,722	65.5	14.80	3.32	2.11	4.37	0.23	4.94	0.11	0.42	0.10	<0.01	0.02	0.01	3.14	99.08
G156W	9,081,070	678,649	67.39	14.55	3.28	1.39	3.49	1.57	4.02	0.08	0.45	0.06	0.01	0.01	0.03	3.44	99.78
G165W	9,082,500	722,600	48.51	18.27	10.14	5.11	2.32	0.18	10.05	0.13	0.94	0.09	0.01	0.02	0.01	3.45	99.24
H002W	9,122,740	466,469	54.31	17.05	8.05	3.73	3.10	0.96	8.84	0.16	0.82	0.14	0.01	0.03	0.02	1.84	99.07
H019W	9,126,334	576,308	56.24	17.54	7.31	3.01	3.37	0.79	7.67	0.17	0.64	0.14	<0.01	0.04	0.03	3.01	99.96
H028W	9,123,513	575,763	49.43	17.25	10.74	3.87	2.24	0.43	8.53	0.13	0.88	0.11	0.01	0.02	0.01	5.80	99.44
H033W	9,091,856	579,512	59.02	16.50	6.80	2.99	3.11	0.88	6.88	0.14	0.64	0.11	0.01	0.03	0.02	2.72	99.85
H035W	9,094,511	577,213	61.28	16.16	6.47	2.74	3.37	1.10	6.47	0.13	0.61	0.11	<0.01	0.03	0.01	1.18	99.68
H087W	9,072,984	688,594	48.48	19.77	8.41	3.64	4.11	0.87	9.29	0.15	0.70	0.05	<0.01	0.02	0.02	4.15	99.65
H094W	9,075,950	687,101	53.47	15.93	5.93	3.60	4.25	0.37	9.96	0.17	0.93	0.08	<0.01	0.02	0.01	4.43	99.14
I020W	9,090,078	570,596	56.01	17.00	7.17	3.79	3.25	0.83	8.73	0.19	0.84	0.13	0.01	0.03	0.02	1.50	99.51
L029W	9,117,422	575,804	59.59	13.91	5.68	1.47	2.60	1.89	6.26	0.30	0.68	0.15	<0.01	0.02	0.01	7.42	99.98
L033W	9,087,060	626,687	76.59	12.69	0.14	0.28	0.31	2.06	1.88	<0.01	0.36	0.05	0.02	<0.01	0.02	3.84	98.25

Table 3-4 Results of Age Determination by K-Ar Method

Sample	UTM (E)	UTM (N)	Rock Name(Field mame) -> Rock Name (based on laboratory tests)	40Arrad(nl/g)	K(%)	40Arair(%)	Age(Ma)
G002	484798	9136354	diorite porphyry -> andesite	0.446	0.535	70.0	21.7 ± 1.9
G125	704298	9077582	quartz diorite -> diorite	0.116	0.170	94.1	17.8 ± 2.5
G146	707233	9073940	porphyrytic dacite -> quartz porphyry	0.641	0.920	63.3	18.2 ± 1.5
G156	678649	9081070	dacite -> quartz porphyry	0.498	1.286	61.3	10.1 ± 0.5
G165	722600	9082500	basalt -> andesite	0.087	0.138	92.2	16.5 ± 1.7
H002	466469	9122740	basalt -> andesite porphyry	0.650	0.860	75.6	19.7 ± 0.9
H028	575763	9123513	andesite ->andesite	0.322	0.400	83.6	21.0 ± 2.6
H033	579512	9091856	prophyrytic andesite -> andesite	0.409	0.730	72.6	14.6 ± 1.3
H087	688594	9072984	prophyrytic andesite -> andesite	0.127	0.140	89.6	23.7 ± 3.5
H094	687101	9075950	porphyrytic andesite -> andesite	0.275	0.365	77.3	19.6 ± 1.3



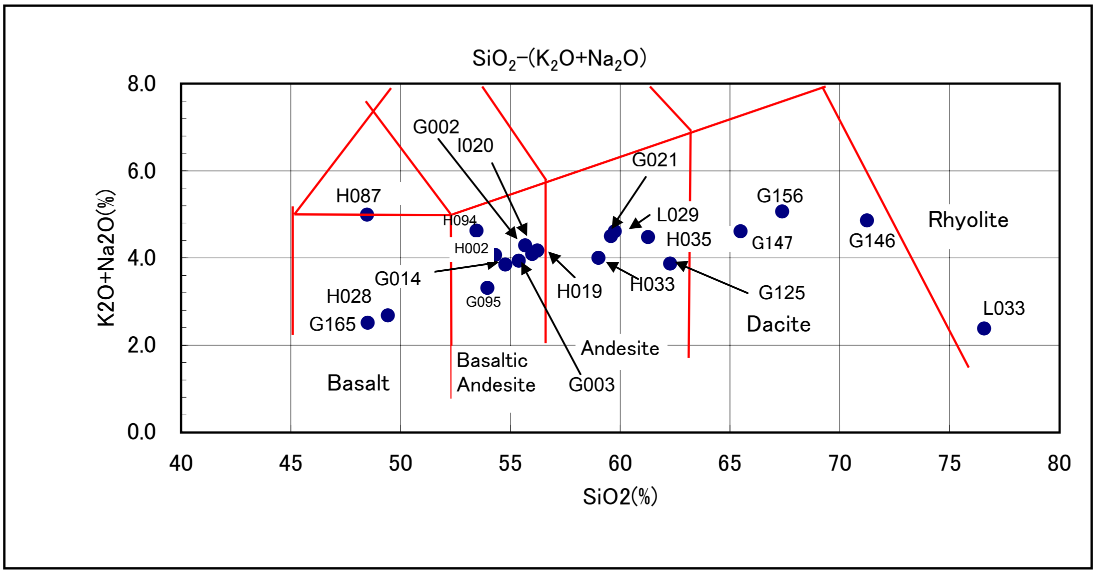


Fig. 3-6 Diagram of Volcanic Rocks in the Survey Area

The alteration minerals were identified in the field, and also at the base camp where a portable spectrometer PIMA was used. This was for reference purposes only and accurate identification was carried out on 50 samples by X-ray diffractometry in the laboratory

The specification of PIMA spectrometer is shown on Table 3-5. The condition of X-ray diffractometry is shown on Table 3-6.

Table 3-5 Specification of PIMA Spectrometer

Name	Integrated Spectronics PIMA III (Portable Infrared Mineral Analyizer)
Measured Wavelength	1, 300 - 2, 500nm
Sampling Interval	2 nm
Control Computer	IBM laptop computer
Software for Analysis	PIMA Viewer

Table3-6 X-ray Diffractometry Conditions

Equipment	(1) Rigaku Electric RINT2100 (2) Max Science MO3XHF22E
Measured Angles	4° - 40°
Target（X ray Wavelength）	Cu（1.54056Å）
Slit Interval	1° － 1° － 0.15mm
Scanning Speed	2° /min

Identified alteration minerals are shown in Table 3-7. Of these the following minerals are considered to be related to mineralization. Sericite, mixed-layer clay minerals (smectite/sericite and smectite/chlorite), smectite, kaolin minerals (kaolinite) and others. Chlorite and epidote are also considered to be a probable product of alteration related to mineralization.

- Sericite: Sericite is often found in zones where mineralization is widely spread in the central southern part of the survey area.
- Mixed-layer clay minerals (smectite/sericite, smectite/chlorite): These minerals occur in zones overlapping or adjoining the distribution of sericite.
- Smectite: Smectite occurs paragenetically with mixed-layer minerals, but the distribution area is narrow.
- Kaolin minerals (kaolinite): These minerals were detected in the West and East areas of the survey area.

Table 3-7 Results of Xray diffraction Analysis

Sample No.	qz	Kf	pl	sm	chl	chl/sm	se	se/sm	ep	kao	pyr	ja	cal	gyp	py	hm	al	
G004	○		○	△														
G006	○		○	○											·			2.95○ 8.43○
G007	△		·	○													○	
G009															△			4.95△ 4.06· 3.22·？
G015	○		○	○														
G016	○		○		○		·						○					
G017	◎		·	·														
G020	◎				△													
G023	◎		△		△								·		·			
G026	◎				·										·			
G027	◎		○		·										·			
G050	◎						·											
G056	◎														·			
G057	◎		△	·?			·											
G063	○				△		·						·？					
G069	◎									○								
H008	◎																	
H010	△																	
H011	△																	
H012	·																	
H027	◎																	
H048	◎						△											
H050	◎						·											
H061	◎						·			△					△			
H063	◎									·					△			
I019					○			·							·			
I021	◎				·		·											
I023	◎				·		·								·			
I049	△		○		△													
I051	◎							·							·			
I082	◎		△	?	△		·								·			
J037	◎	·			·?					·？								
J041	◎	·	○															
J044	◎														·			
K008	○		△?										·				heulandite○	
K009	○		○?										○				heulandite○	
K012	○																heulandite○	
K029	◎		·		△		·								·			
K031	○		·		○			·										
K046	◎									·								
K050	◎	○																
K053	◎									○								
L009	◎			·											·			
L016	◎																	
L017	◎			·?			·											
L018	◎			·			·											
L019	◎							·？										
L021	◎						·								·			
L024	◎	△					·								△			
L031	△			○											·			

qz:quartz, Kf: potash-feldspar, pl:plagioclase, sm:smectite, chl:chlorite, chl/sm:chlorite/smectite mix layered mineral
se:sericite, se/sm:sericite/smectite mixed-layer mineral, ep:epidote, kao:kaolin, pyr:pyrophyllite, ja:jarocite
al:alunite,. cal: calcite, ank:ankerite, gyp:gypsum, py:pyrite, di:diaspore, hm:hematite,
x: unidentified mineral with the d value(Å)
Amount:◎>○>△>·>×

Table 3-8 Results of Microscopic Observation of Polished Sections (1/2)

Sample	Ore minerals										Gangue minerals								
No.	Py	Cp	Sph	Bo	Co	Au	Gn	Hm/Mt	Bar	others	si	pl	kf	ser	chl	clay	ana	zm	others
G020	○						・			Cha(・)	◎	○			○		△	・	cal(△),apa(・)
G021	◎	◎		△		・	・			Goe(○)	◎			○		△			
G027	◎		◎				△												ank(◎)
G028	◎	○					△				◎			○					
G109	◎										◎			△		△			
G112	◎						・				◎					△			
G124	◎									Sch(・),Pyr(・)		◎		○		○		・	gyp(△)
G127	○	・									◎	◎			○		△		cal(△),apa(・)
G129	◎	○					・				◎			○					
G135	○	・	○							Goe(△)	◎			・					
G149	◎	○	△		△		・				◎			○					
H063	◎									Fe-sulfate(△)	◎					○			
I070	◎						・			Goe(△)	◎					○			
I077	○	・								Goe(・)		◎			◎	○			apa(・)
I079	◎											○				○			cal(○)epi(○)
I083	◎								・	Cag(・)	◎			○		○	・		
J037						・		・		Goe(・)	◎		○			○	△	・	
J044	△							・	・		◎					△			
J052	○		△		△		△				◎								sul(△)
K056	○								△	Goe(△)	◎					△			
L009	△									Arp(・)	◎			△					ilm(・)
L016	◎										◎					△			
L024	△		△				△			Goe(△)Aca(・)	◎		◎			△			
L030	◎		・				・		・		◎								
L034	○																		kao(◎)
L042	○		△								◎	○			○				tit(△)

Abbreviation:
Py=pyrite,Hm/Mt=hematite/magnetite,Cp=chalcopyrite,Arp=arsenopyrite, Gn=galena, Goe=goethite, Aca=acanthite, Au=gold, Co=covellite, Bo=bornite

Table 3-8 Results of Microscopic Observation of Polished Sections (2/2)

Sample	Ore minerals										Gangue minerals								
No.	Py	Cp	Sph	Bo	Co	Au	Gn	Hm/Mt	Bar	others	si	pl	kf	ser	chl	clay	ana	zm	others
TRII-1A	○	◎		・						Mo(△)	◎				○				
TRII-2	◎									Goe(△)	◎				△	△	△		
PLS-6	◎	△									◎			△	△				
PLS-9	○	◎								Bis(△)	◎		△		△				spi(・)
TS-08R	○									Goe(△)	◎		・		△				tit(・)
B008R			○				・	△			◎								cal(◎)
B021R-A	○	△								Goe(△)Bis(△)	◎				△	○			
A087RM	・									Goe(△)	◎								
A002RM	○	△		・			・				◎								
A009FM	◎						・				○		◎			○			
A011RM	○						・			Goe(○)	◎	○	◎						
A023FM	○	◎								BiTe(・)	◎			○					
A028FM	○	・			・					Goe(○)	◎								
A029FM	・	・			・					Goe(○)	○				◎		△	・	
A045RM	◎		○				・			Arp(○), Sch(・)	◎			○					
A065FM	○	△			・				・		◎			△			・		
A078FM	◎									Arp(・),Goe(・)	◎			○					
A084FM	○	△	△		△					Goe(○)	◎								
A096FM	◎										◎			○			・		
A097RM	△	・	・					◎			◎								
B016RM	◎	△			○		・			Goe(△) ,Bis(△)	○								
B018R								◎			○								
B019F	◎	△					・				◎			○		△			
C008R	◎	△	△		△					Goe(△)	◎				○				

Abbreviation:

Py=pyrite,Hm/Mt=hematite/magnetite,Cp=chalcopyrite,Arp=arsenopyrite, Gn=galena, Goe=goethite, Aca=acanthite, Au=gold, Co=covellite, Bo=bornite

Sph=sphalerite, Sch=scheelite, Pyr=pyrrhotite, Bis=bismuthinite, Cha=chalcanthite, Bar=barite, Cag=chlorargyrite, Mo=molybdenite, BiTE=tellurobismuthite

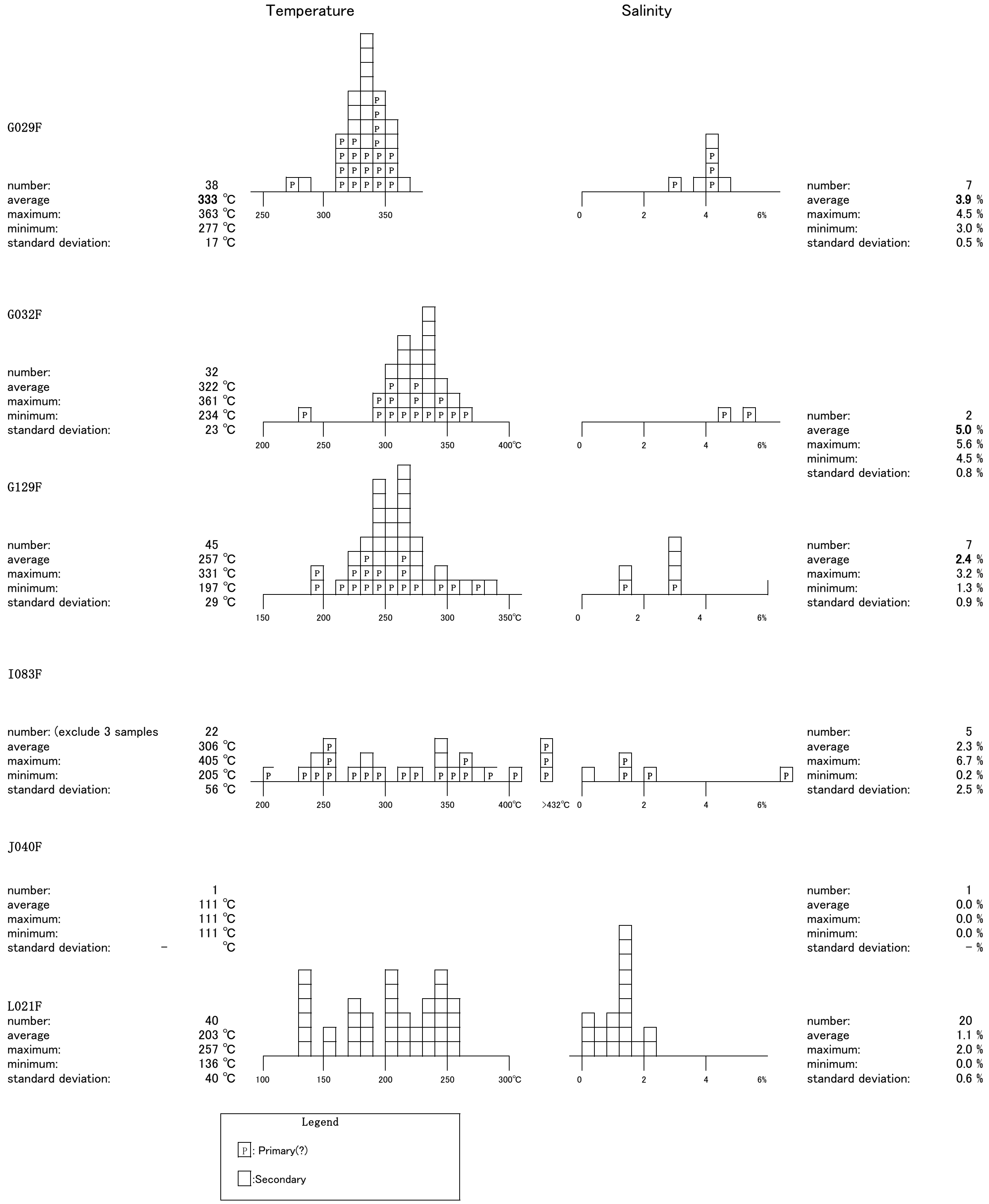


Fig.3-7 Homogenization Temperatures and Salinities of Fluid Inclusions

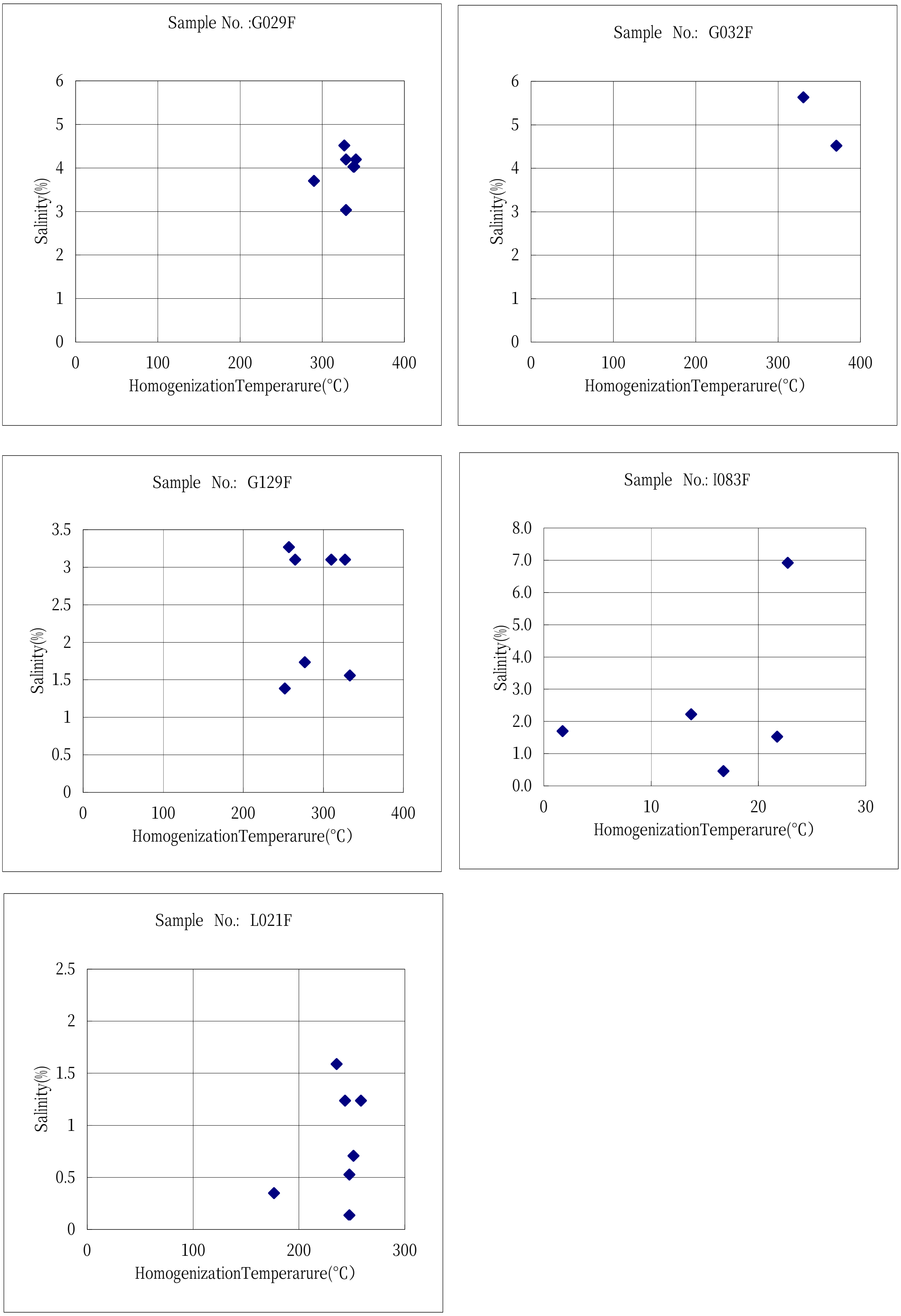


Fig. 3-8 Correlations between Temperatures and Salinities of Fluid Inclusions

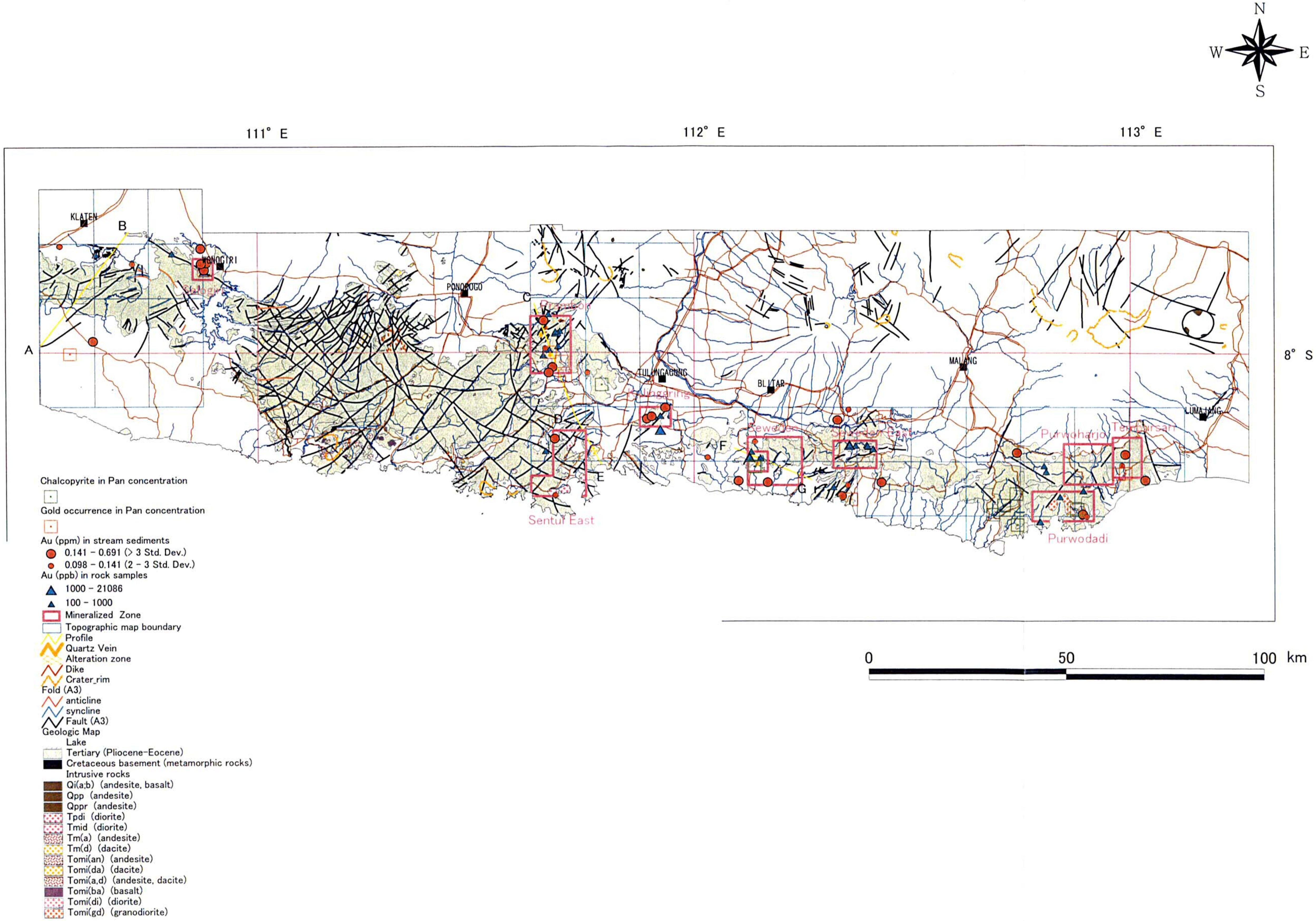


Fig. 3-9 Mineralized Zones of the Survey Area

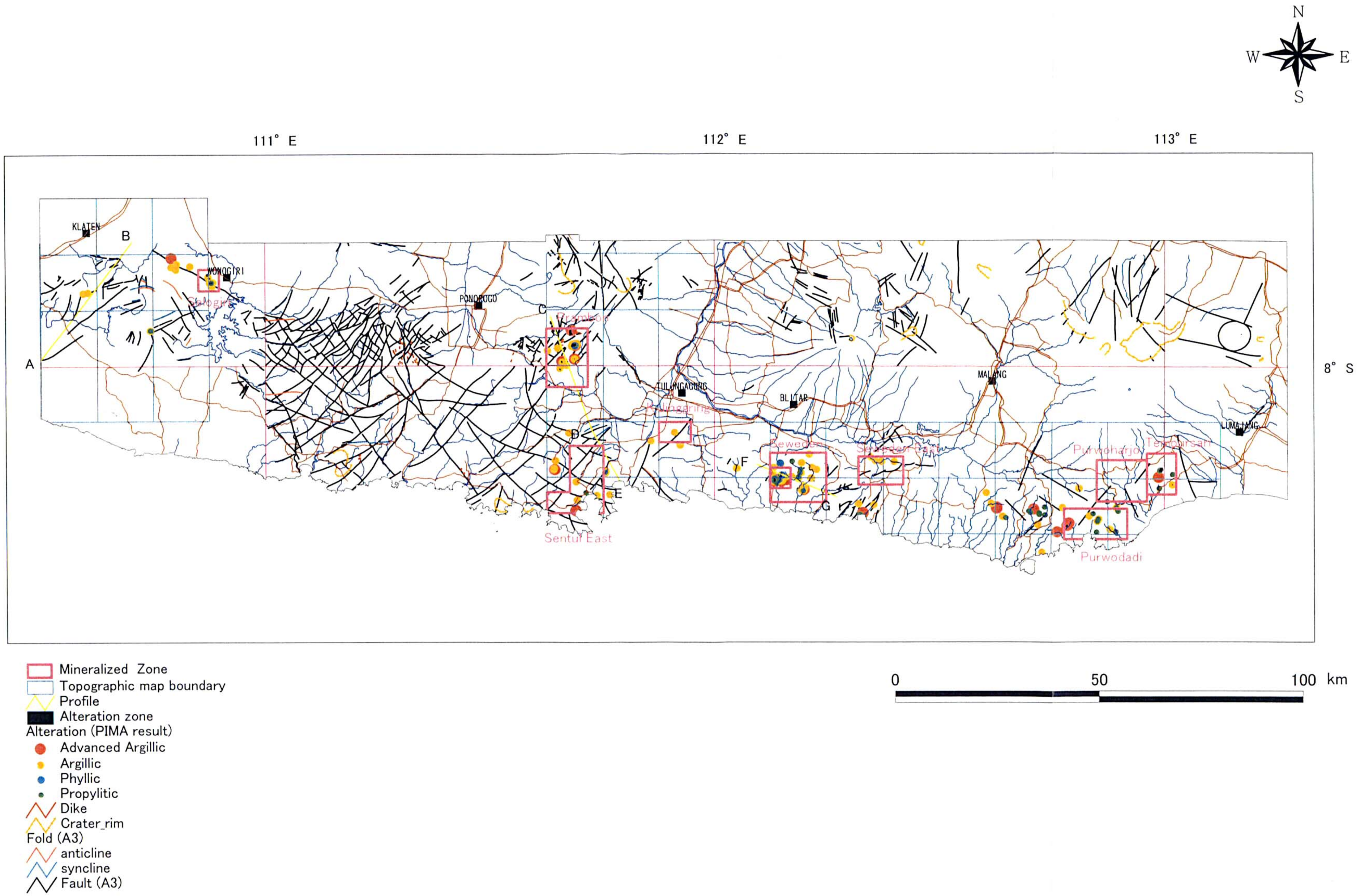


Fig. 3-10 Alteration Map of the Survey Area

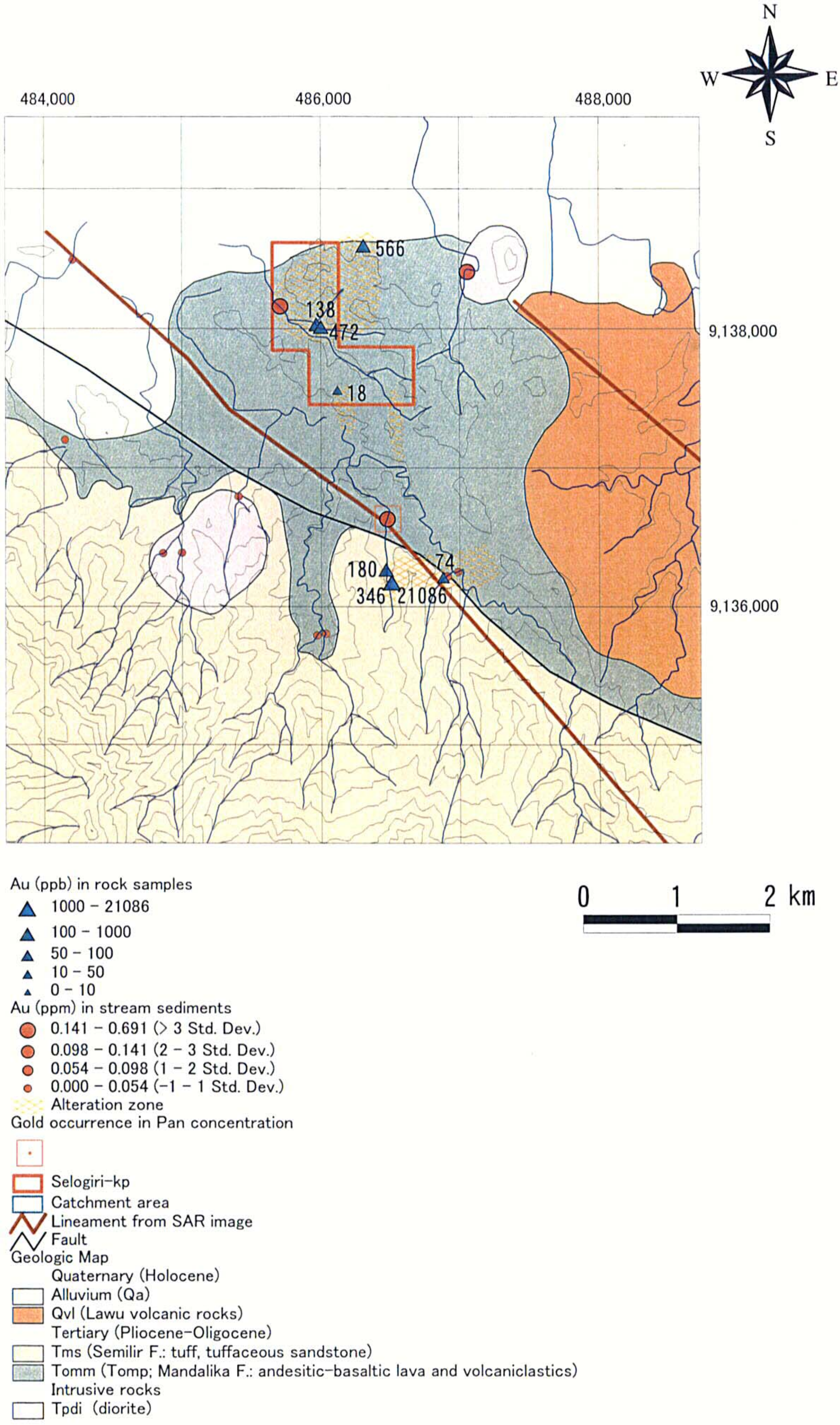


Fig. 3-11 Survey Results of Selogiri Area

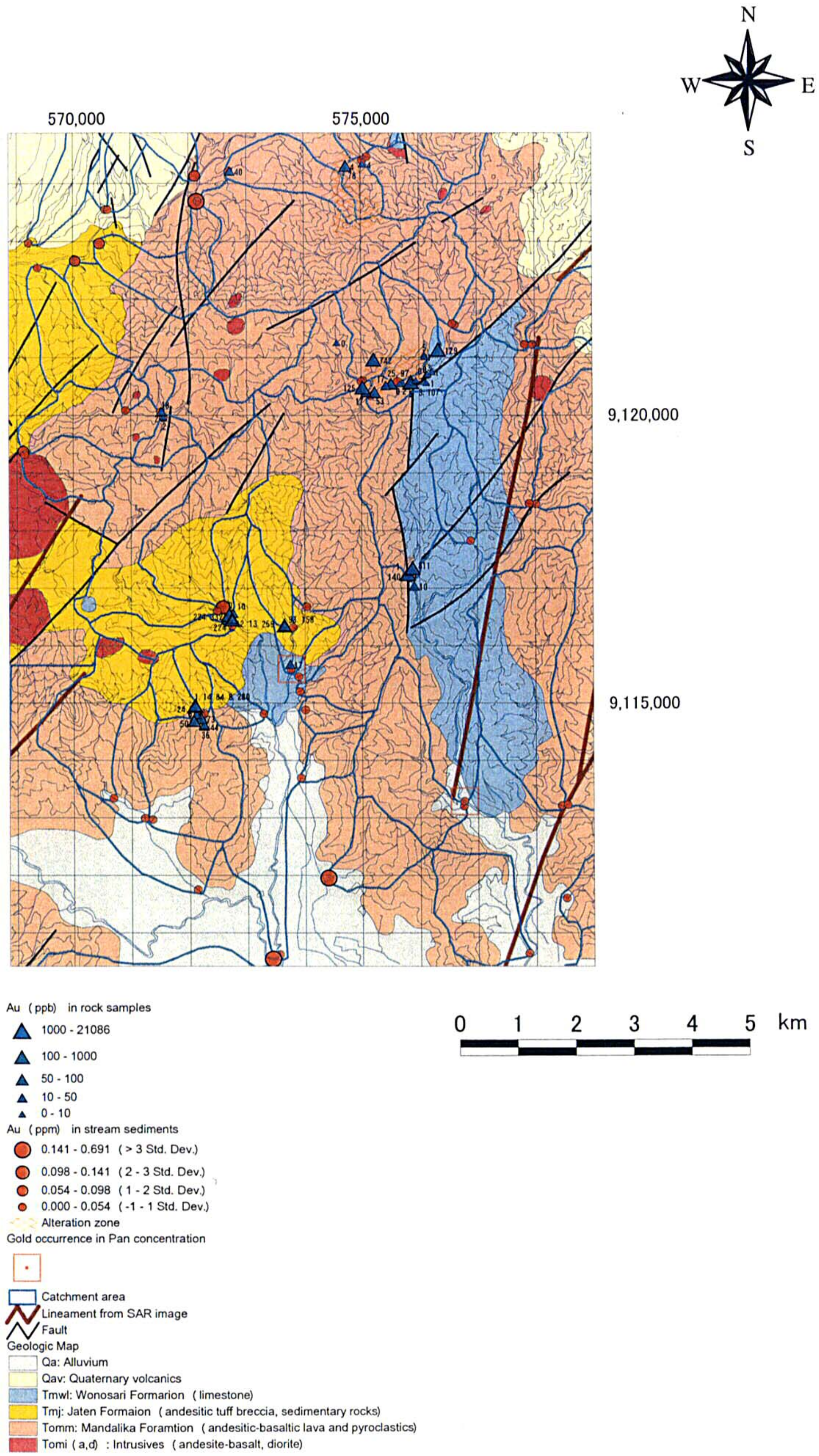
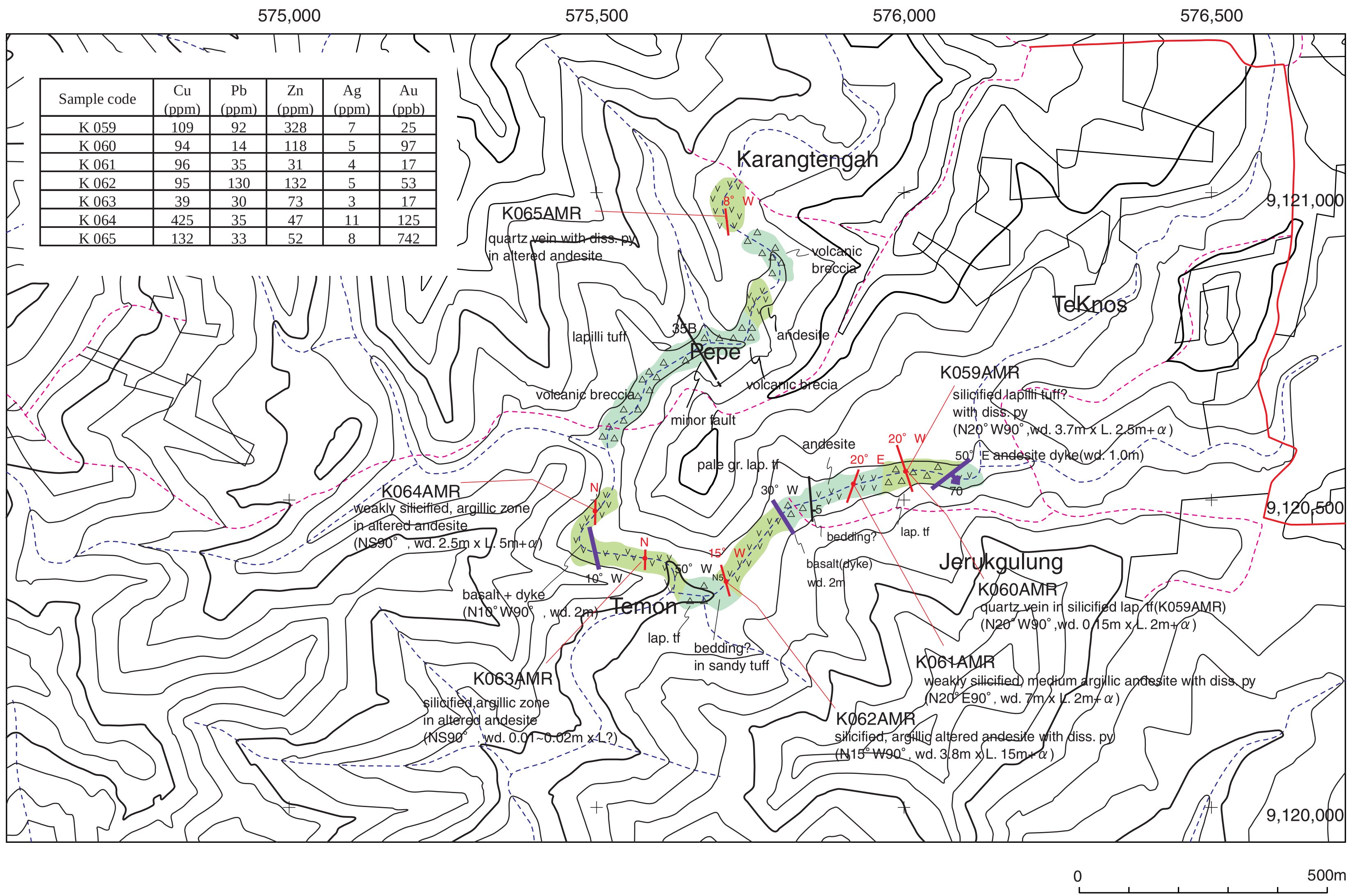
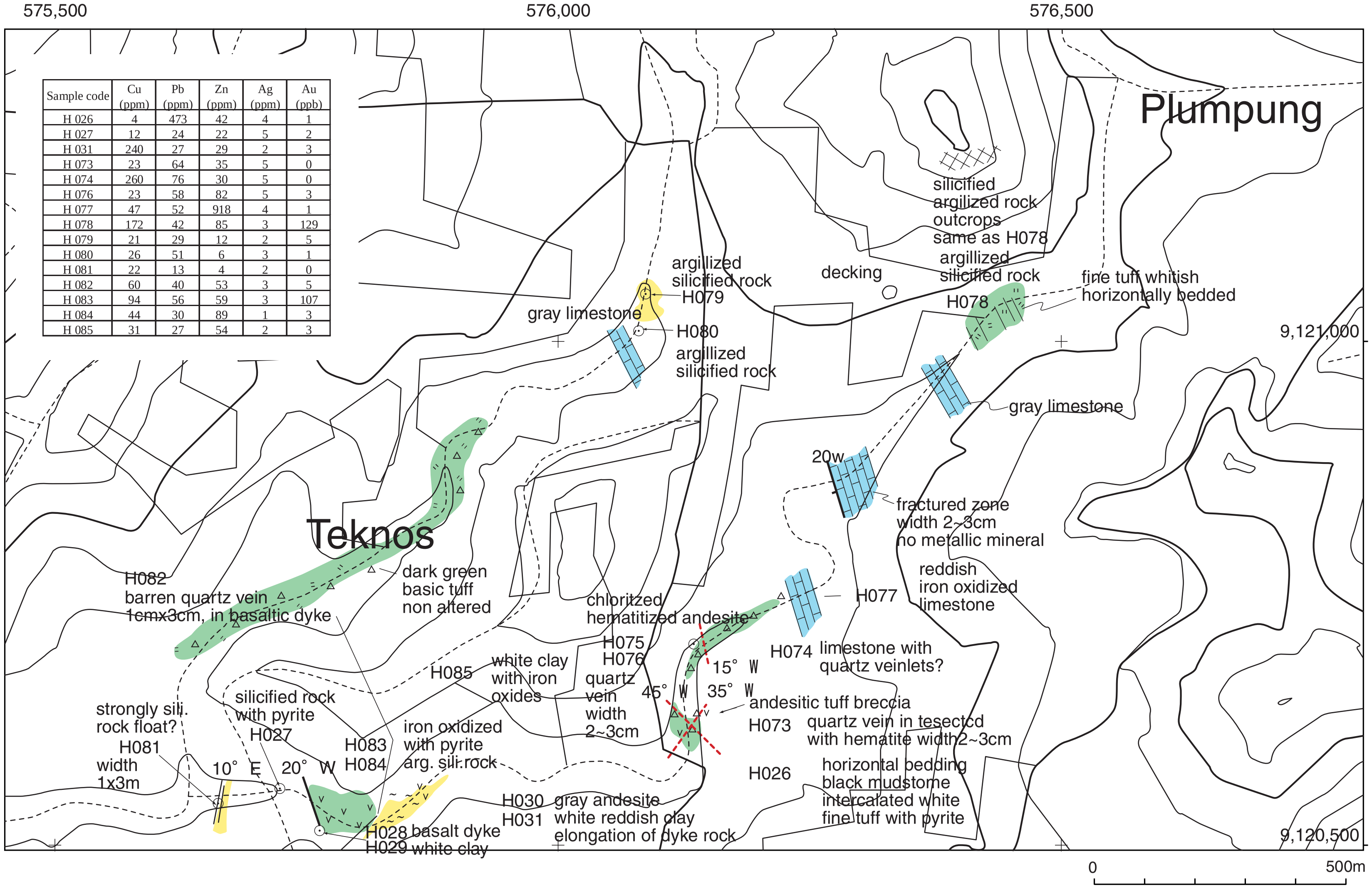


Fig. 3-12 Survey Results of Prambon Area



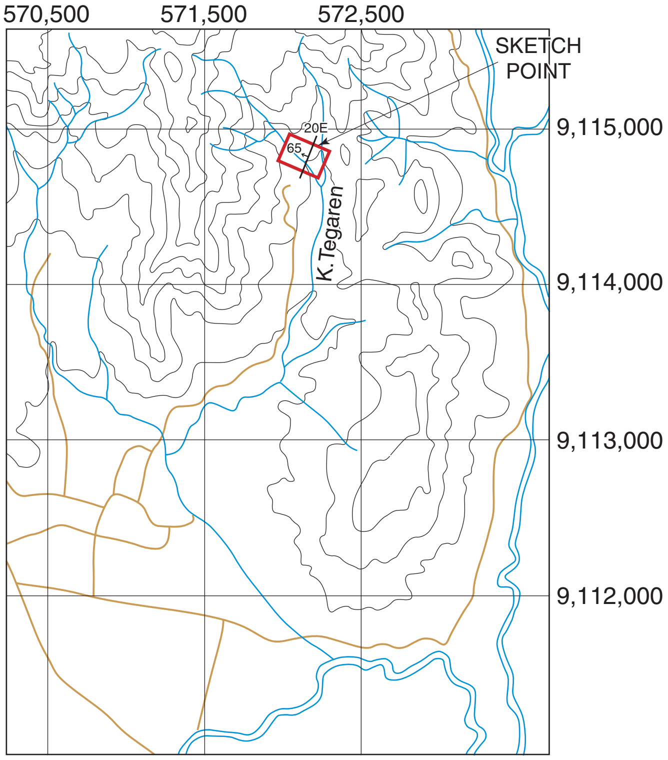
Sample code	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ag (ppm)	Au (ppb)
K 059	109	92	328	7	25
K 060	94	14	118	5	97
K 061	96	35	31	4	17
K 062	95	130	132	5	53
K 063	39	30	73	3	17
K 064	425	35	47	11	125
K 065	132	33	52	8	742

Fig.3-13(1) Sketch of the Mineralized Area (3) Prambom Area



Sample code	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ag (ppm)	Au (ppb)
H 026	4	473	42	4	1
H 027	12	24	22	5	2
H 031	240	27	29	2	3
H 073	23	64	35	5	0
H 074	260	76	30	5	0
H 076	23	58	82	5	3
H 077	47	52	918	4	1
H 078	172	42	85	3	129
H 079	21	29	12	2	5
H 080	26	51	6	3	1
H 081	22	13	4	2	0
H 082	60	40	53	3	5
H 083	94	56	59	3	107
H 084	44	30	89	1	3
H 085	31	27	54	2	3

Fig.3-13(2) Sketch of the Mineralized Area (3) Prambon Area



Sketch at the upper stream of
K.Tegaren, Trenggalek
(9,114,950N, 572,093E)

Sample code	Cu	Pb	Zn	Ag	Au
	(ppm)	(ppm)	(ppm)	(ppm)	(ppb)
L 017	198	32	98	7	280
L 018	186	21	94	4	8
L 019	178	14	57	2	14
L 020	96	19	77	2	1
L 021	45	18	41	7	84

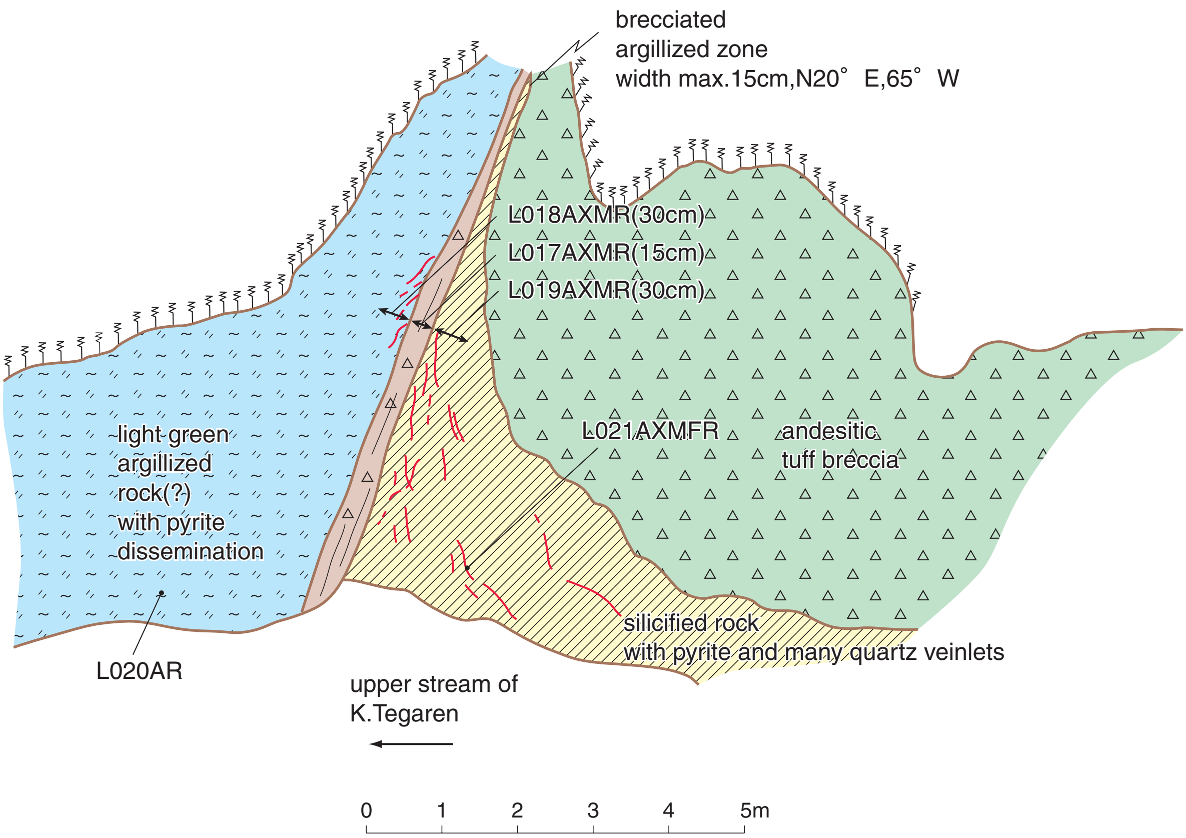


Fig. 3-13(3) Sketch of the Minerlized Area (3) Prambon Area

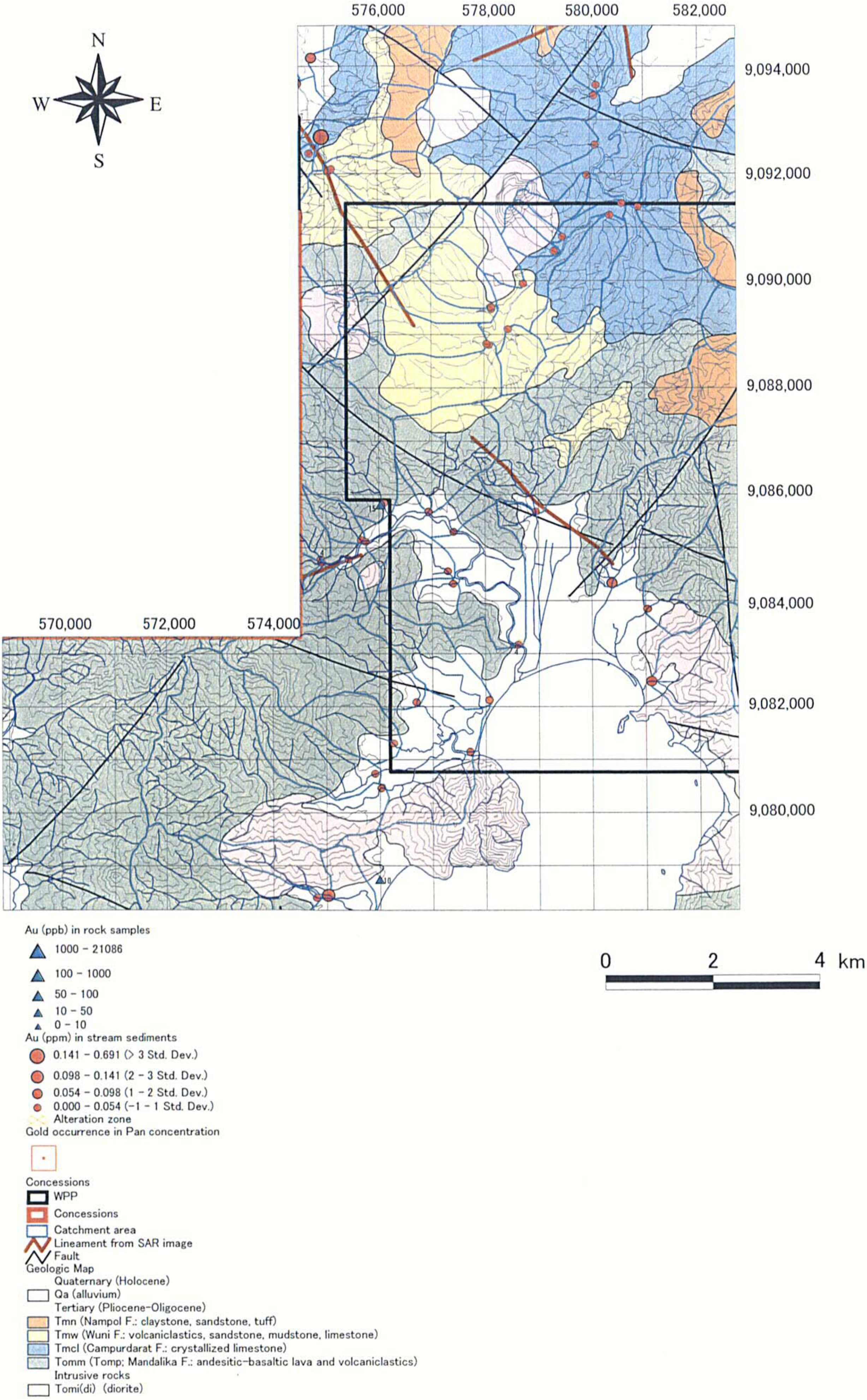
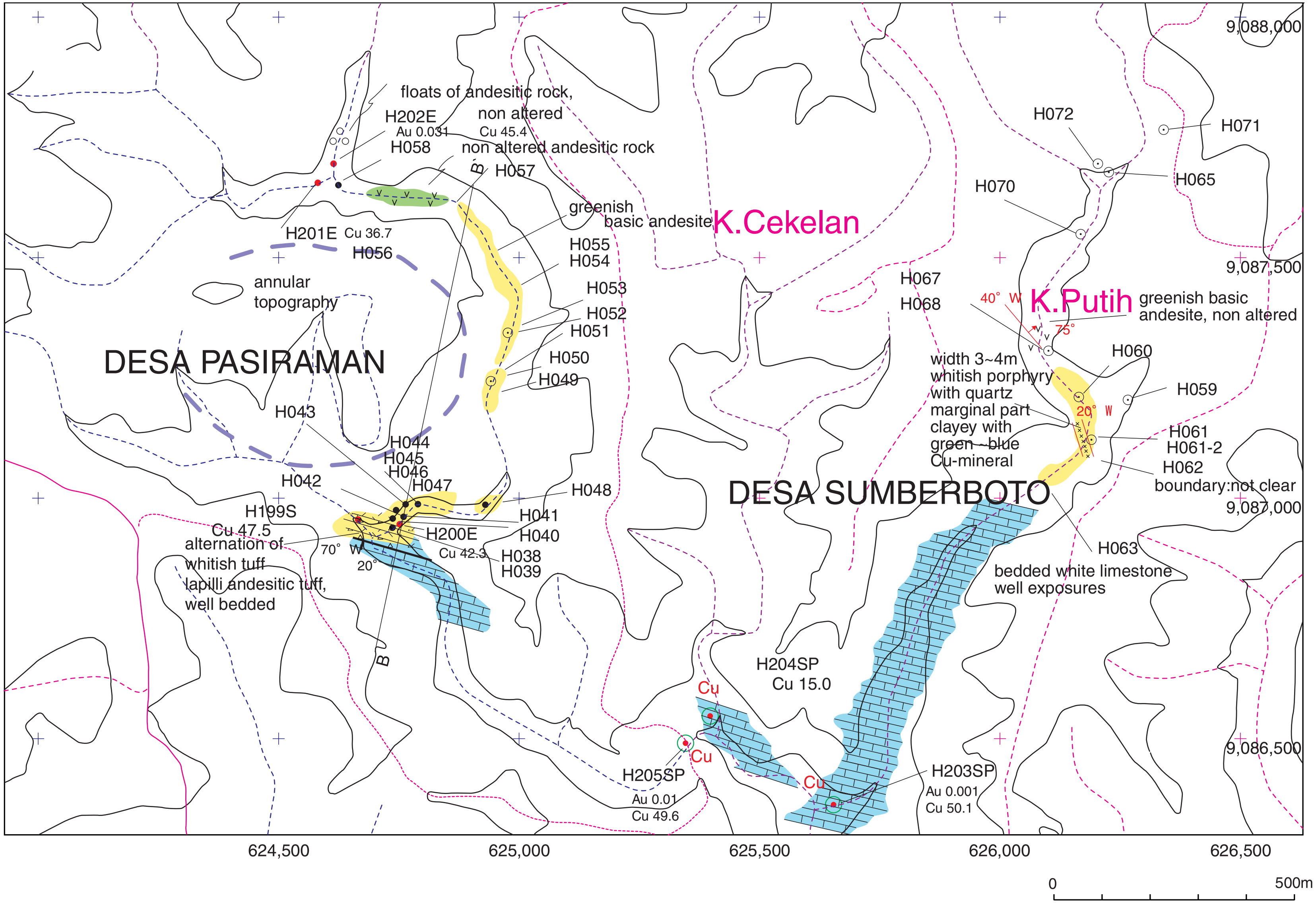


Fig. 3-14 Survey Results of Sentul East Area



Sample code	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ag (ppm)	Au (ppb)
H 039	16	18	8	2	3
H 040	3	9	4	1	4
H 041	6	25	7	13	4
H 042	58	27	18	2	3
H 043	7	26	4	2	9
H 044	10	13	15	1	4
H 045	12	17	20	2	3
H 046	34	34	61	6	12
H 047	9	17	27	2	1
H 048	31	26	23	2	3
H 050	9	23	63	1	4
H 052	18	36	18	5	21
H 053	60	12	31	7	12
H 054	5	10	14	2	1
H 055	14	41	26	2	4
H 056	12	15	36	2	6
H 058	8	25	20	2	2
H 059	110	31	12	2	2
H 060	48	57	159	3	8
H 061	9260	58	41	5	10
H 061-2	3090	67	33	3	1
H 062	10510	47	55	4	4
H 063	136	53	15	1	60
H 065	46	23	22	2	3
H 067	166	24	165	2	34
H 068	27670	99	427	9	16
H 070	28	22	116	1	3
H 071	22	22	13	3	19
H 072	377	33	12	3	11

Fig.3-15(1) Sketch of the Mineralized Area (5) Seweden Area

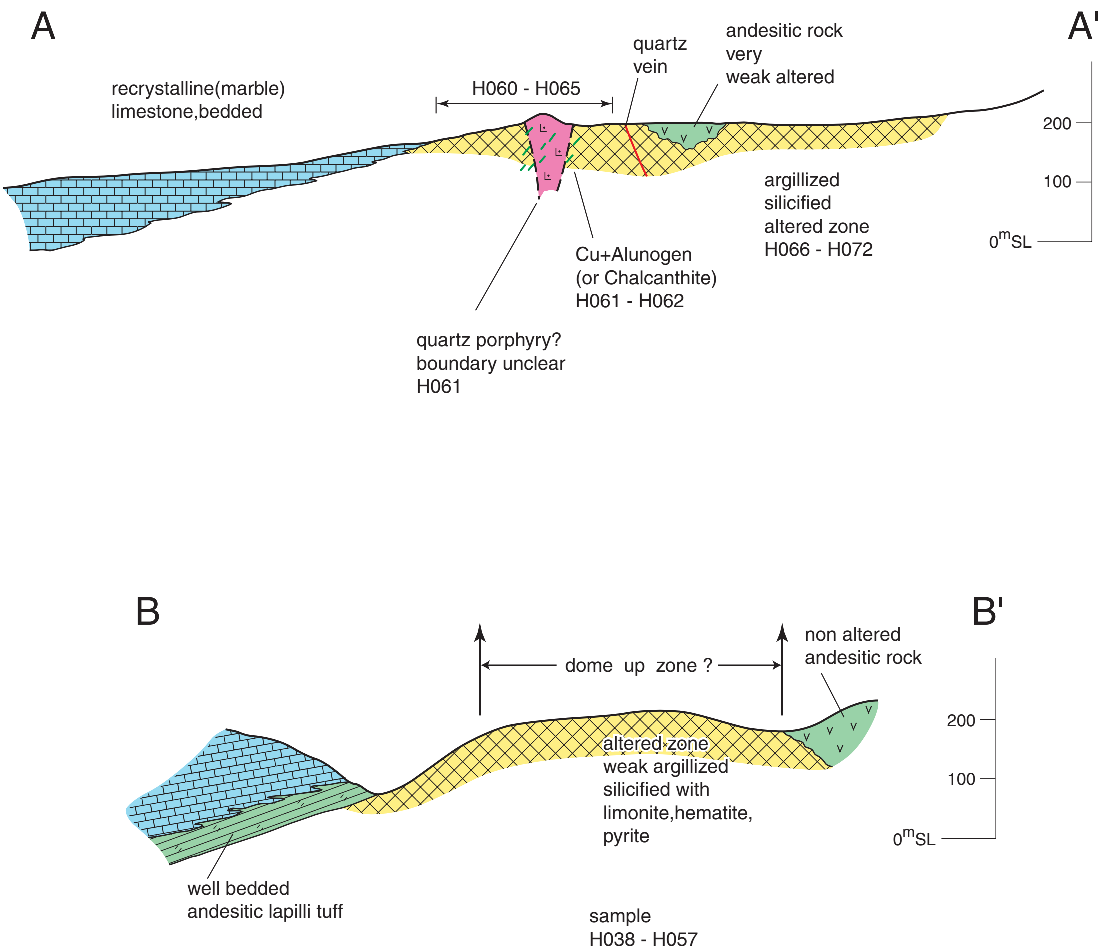
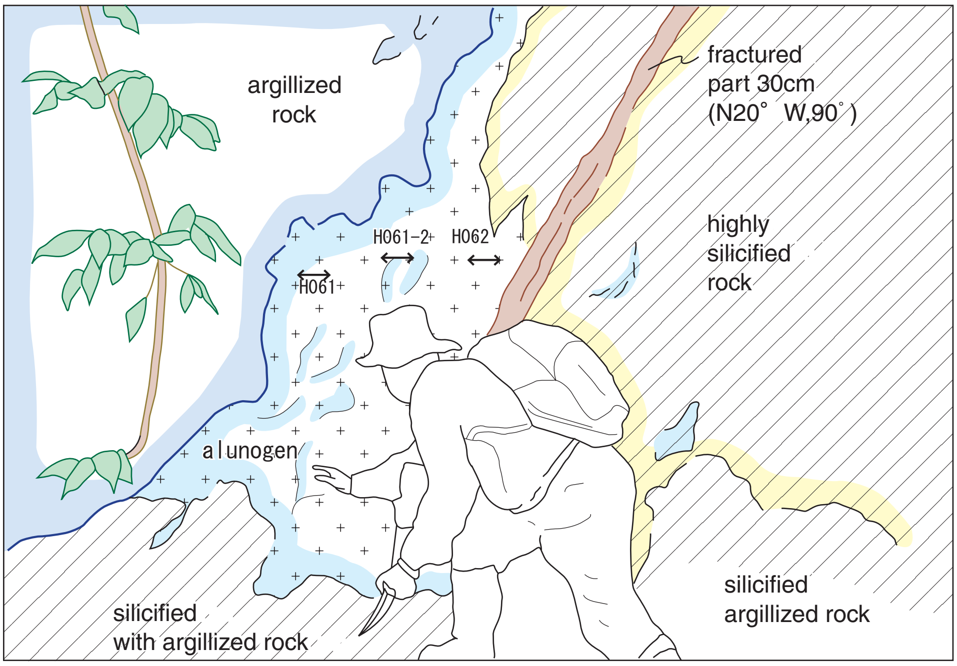


Fig.3-15(2) Geologic Profile of Seweden Area



Sample code	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ag (ppm)	Au (ppb)
H 061	9260	58	41	5	10
H 061-2	3090	67	33	3	1
H 062	10510	47	55	4	4

Fig.3-15(3) Sketch of the Mineralized Area (5) Seweden Area

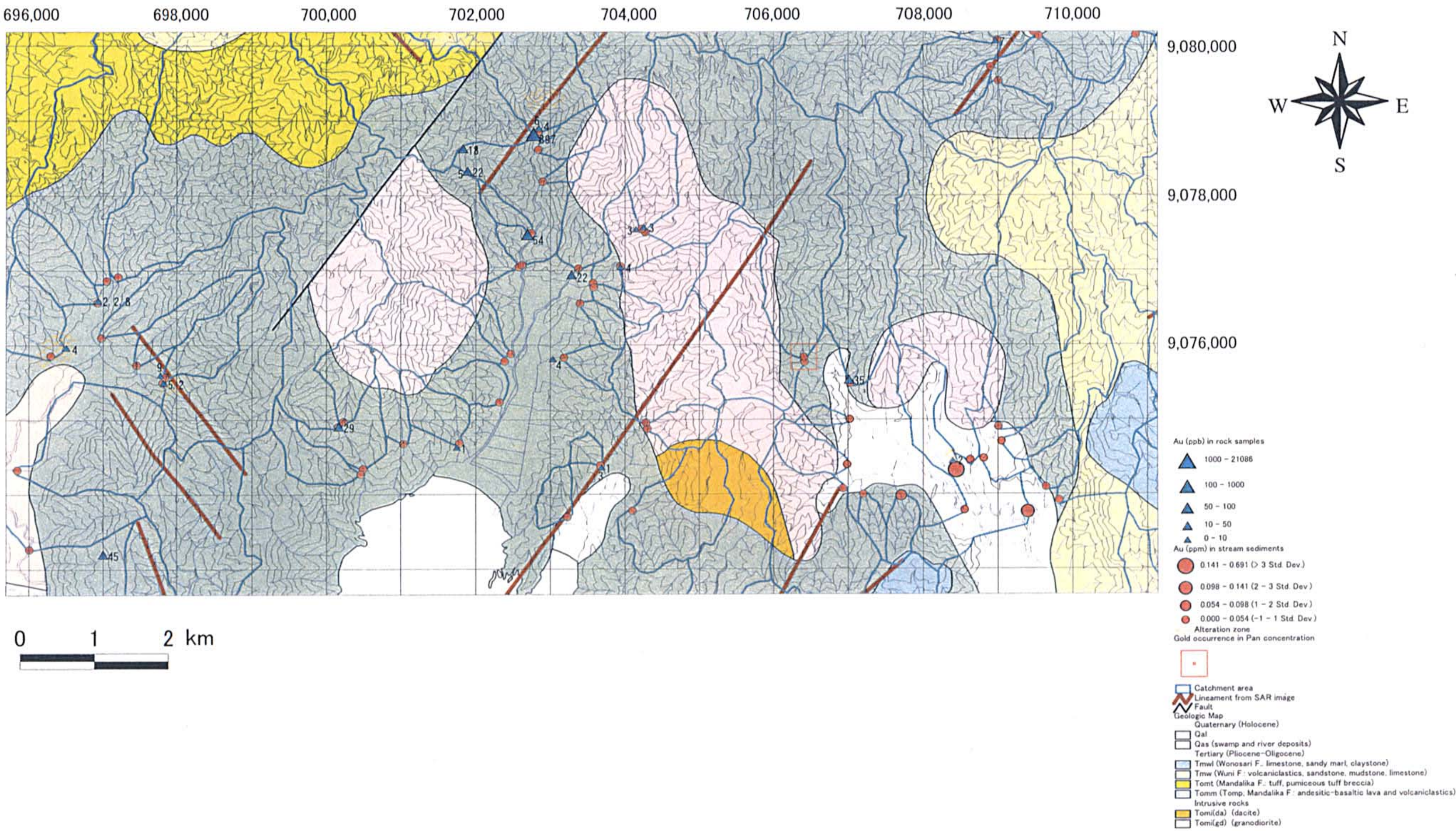


Fig. 3-16 Survey Results of Purwodadi Area

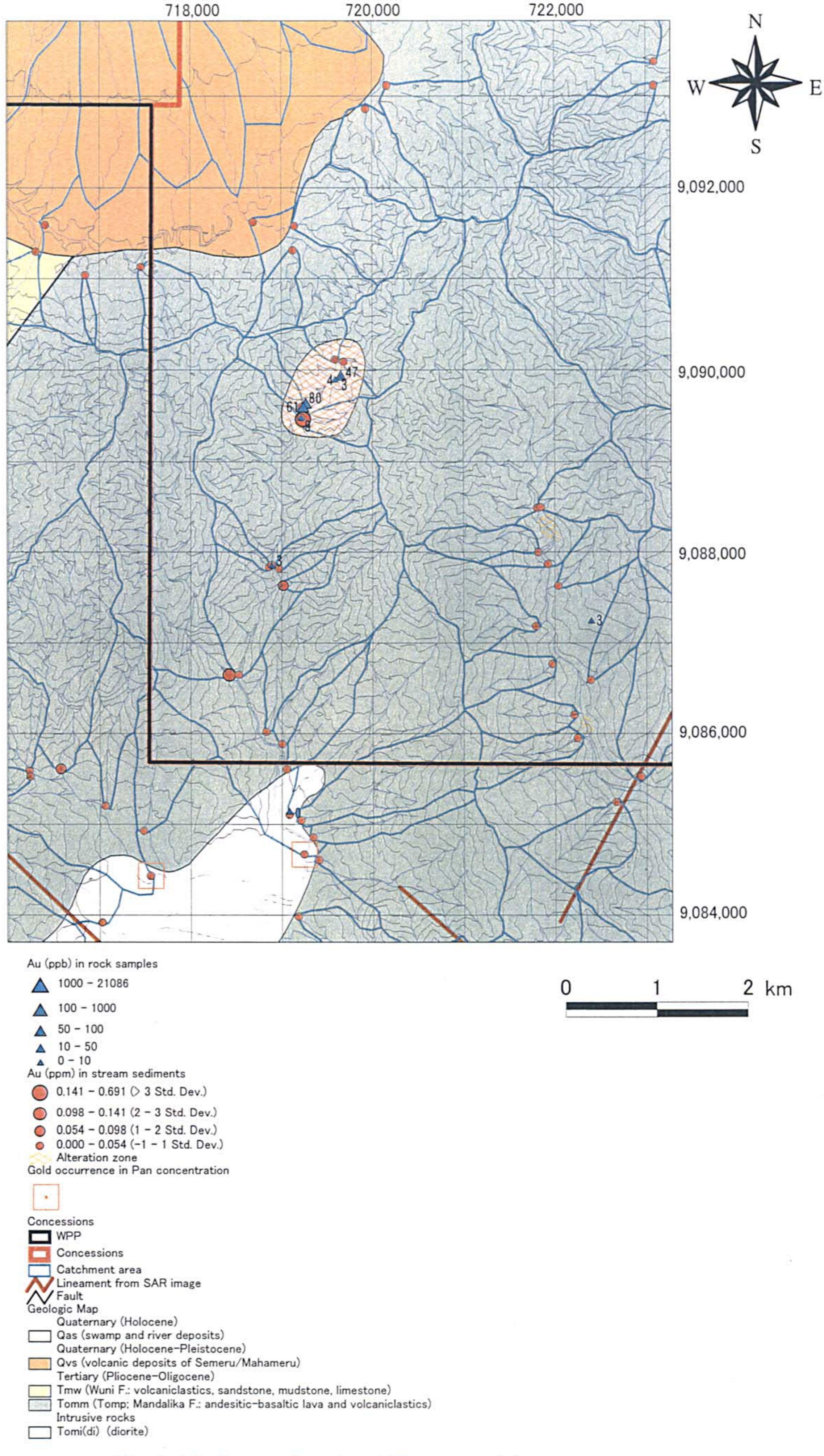


Fig. 3-17 Survey Results of Tempursari Area

2 - 3 Geochemical Survey

2-3-1 Sampling and Analysis Methods

A total of 1, 660 localities were selected in the regional geochemical survey area.

In the field, firstly at the sampling points stream sediments were taken and the - 30 mesh portions were selected with sieves of 30 mesh sieves, then the - 166 mesh portions were collected by 166 mesh sieves. At 83 localities duplicate samples are taken to evaluate the sampling error. Some rivers were dried up while others were not. Therefore, dry stream sediments were sieved without water, while wet stream sediments were sieved with water.

The samples are analyzed for the 49 elements shown Table 1-1 at the ALS Chemex Lab in Canada. The samples are crushed to -75 micron (85% passing) size. Gold is assayed by gravimetric methods. Four acids were applied for digestion of the samples. Mercury is analyzed by cold vapor method. Other 47 elements were analyzed by ICP method.

Pan concentrates were collected at the 302 localities. The concentrates were observed by microscopy to identify heavy minerals. The non-magnetic portions of the concentrates were separated and provided for chemical analysis.

2-3-2 Results of analysis

(1) Results of analysis

The results are appended in Table A-4. The statistics of the components are laid out in Table 3-10.

(2) Sampling errors

As seen in Fig. 3-19 for duplicate samples, the analytical results of the elements are judged to be beyond analytical errors. The analysis of overlapping samples of individual sampling sites fluctuate. The reason for the fluctuation of the values is presumed to be mainly due to the difference of localities, but should be investigated further.

(3) Dry sieving and wet sieving

At 10 localities a pair of samples were taken one by dry sieving and the other by wet sieving.

The values of Fe and Ti, presumably, most sensitive elements that constitute ilmenite and magnetite in the pairs, do not appear to show significant differences. The cause of the comparatively large differences in gold and silver values are mainly due to the difference of localities.

(4) Correlation among elements

- Au: As seen in Table 3-11, Au has positive correlation with Ag and Hg, but does not show notable correlation with other elements such as As, Hg, Pb, Zn, and Cu.
- Ag: Ag has positive correlation with Cu and Hg
- Cu: Positive correlation is observed with Ag and Ga. but does not show notable correlation with other base metal elements such as Pb and Zn.
- Pb: Pb does not show notable correlation with other base metal elements.
- Zn: Positive correlation is observed with Co, Ni, Ti and V.
- Mo: Positive correlation exists with As, Sb, Nb and U.
- W: Positive correlation exists with As, Sb, S and Mo, and weak positive correlation may exist with Ce, Li, Ta, Nb and Th.

- Other elements: Correlation among the so-called siderophile elements (Fe, Ga, In, Ni, Co, V, Cr, and Mn), and that among the components of rock-forming minerals (K, Al, and Mg) are inferred to reflect the nature and alteration of the host rock. Correlations with Bi, Cd and Pb, Te, In may exist, but show low correlation coefficients between Bi, Cd and Pb and Zn are low.

(5) Influence of geology of the hinterlands

The geology of survey area is mainly comprised of andesitic-basaltic Tertiary volcanics rocks and volcaniclastics. However, limestone and other sedimentary rocks are underlain the survey area. Therefore, the threshold values should be determined to extract geochemical anomalies. For example, Cu values is 5ppm where limestone presumed to be underlain since Ca content of the stream sediments is about 4%, while Cu average content in mafic volcanic rocks is 72 ppm.

(6) Principal component Analysis

The correlation between elements does not sufficient to evaluate indicating elements for gold, silver and base metal elements. Therefore, principal component analysis is tried to apply.

-Database: A set of data consisting of 49 elements of 1, 660 samples

-Factor loading: The first components contribute 18% of factor, and 80% of cumulative contribution needs a total of 14 components. That indicates many factor reflect the variation of the 49 elements.

-The first principal component: Fe, Mg, Ti, V, Cr and V show positive factor loadings, be, Ta and Tl show negative. Therefore, the first principal component may reflect the influence of geology of catchments areas and/or hydrological characters.

-The second principal components: Cu, Zn, Fe, Ni, Mn, Ni, Ti, V and In show positive factor loadings. Therefore, the second principal component may reflect the influence of geology of catchments areas.

-The third principal components: Ca shows positive factor loadings, and Rb shows negative factor loadings. Therefore, the third principal component may reflect the influence of limestone of catchments areas.

-The fourth principal components: Al, Na, K and Rb show positive factor loadings. Therefore, the fourth principal component may reflect the influence of acidic rocks of catchments areas.

-The fifth principal components: As, Mn, Mo, Se Sb and S show positive factor loadings. Therefore, the fifth principal component may indicate the influence of mineralization of catchments areas. However, Au, Ag, Cu, Pb and Zn show low factor loadings. The reason should be investigated.

-The sixth principal components: Bi, Cd, In and Te show positive factor loadings. Therefore, the sixth principal component may indicate the influence of mineralization of catchments areas. However, Au, Ag, Cu, Pb and Zn show low factor loadings. The reason should be investigated.

-The seventh principal components Au, Ag and Hg show positive factor loadings. Therefore, the seventh principal component may indicate the influence of precious metal mineralization of catchments areas.

-The eighth principal components: No element shows high positive factor loadings. Therefore, it is difficult to determine what reflects the eighth principal component. Relatively high positive factor loadings of Nb, Ta and W may indicate the influence of mineralization of catchments areas and hydrological characteristics of the constituent minerals.

-The ninth principal components: Cu, Mo, Mg and Al show positive factor loadings. Therefore, the ninth principal component may indicate the influence of base metal mineralization.

In summary, the sixth and seventh principal components may reflect mineralization of the area.

(7) Distribution of anomalies of the elements

The field observation, and the analytical results show the mineralization of the survey area Au, Ag, Cu-Mo, Pb-Zn. From the analytical results, Au, Cu, Pb, As are considered to be the most effective indicator elements. Hg, Zn and Mo may be also considered to be effective pathfinders of the survey area. The distribution of the anomalies of these elements is as follows.

[Au]

The content of Au in stream sediments is generally low, and thus threshold value of 54(38)ppb was used (The figures in the parenthesis is the value of the phase 1) . Anomalies of over 54ppb were concentrated at 7 localities, namely (a) Selogiri district, (b) Prambon district, (c) Jinggring River district, (d) Sentul East district, (e) Seweden district, (f) Purwodadi district, and (g) Tempursari district. The four districts of (a), (b), (d), and (g) districts are either near known prospects or existing concessions. Sporadic anomalies are also found in Wonosari, east of Blitar and Southeast of Malang.

Of the above, anomalies higher values are located at the following localities.

(a) Selogiri district: G037S (614ppb), G040S (400ppb), G041S (7.4ppm), G042S (691ppb)

(b) Prambon district: G095S(95ppb), H093E(164ppb), L070S(100ppb), L080E(175ppb), L082E(205ppb), L093S(82ppb)

(c) Jinggring River district: G079E(0.287ppm), G081E(0.450ppm), G112E(0.146ppm)

(d) Sentul East district: I087S(0.351ppm),

(e) Seweden district: K189S(0.226ppm), . I142S(0.099ppm), H207S(0.173ppm), . H140S(0.118ppm),

(f) Purwodadi district: L233S(0.180ppm), L238S(0.119ppm),

(g) Tempursari district: I284(0.307), I273S(0.124ppm), G231S(0.147ppm),

Other anomalies include Wonosari: H057E(0.381ppm), G043S(0.109ppm), J078S(0.102ppm)

-West of Tulungagung: L109S(0.136ppm)

-East of Blitar-Ringinrejo: I206S(0.120ppm), J212S(0.262ppm), G149E(0.241ppm), G151S(0.110ppm), L148S(0.144ppm)

-Southeast of Malang::K205E(2.00ppm).

[Ag]

The threshold value for anomalies is 0.37ppm , which is average and 2 x standard deviation of the Ag values. The 12 samples are anomalous.

(1) Selogiri: G042(0.94ppm), G037(0.88ppm), G040S(0.22ppm), G041S(4.62ppm)
(2) Prambon: H090S(1.90ppm), G091S(0.66ppm), L080S(0.38ppm), L084S(1.54ppm),
G096S(0.57ppm)
(3) East of Sentul East: K081S(1.40ppm), K085S(0.38ppm)
Other anomalies are located in Wonosari:H019E(1.08ppm), H064E(0.60ppm), H044S:1.95ppm,
and Southeast of Blitar: J212S(0.68ppm.)

[Cu]
The Cu values appear to reflect largely the values of the rocks in the catchment areas. Therefore, the threshold values are determined based on geology of the catchment area.

Tertiary volcanic rocks and volcanic rock are grouped into one group termed as 'Tertiary volcanic rocks', and the threshold is determined to be 113ppm, which is average and 2 x standard deviation. Three samples show anomalies:
(1) Selogiri: A024S(186ppm),
(4) Sentul East:100ppm(K094S)
(6) Purwodadi: 96ppm(G204E)

The localities where finer volcaniclastics such as Wuni Formation are underlain are grouped into 'Tertiary tuff'. The threshold values are determined to be 151 ppm, which is average +2 x standard deviation. Two (2) samples are checked to be anomalous:
The samples are taken from the (9) Purwoharjo. The Cu values are exceeding threshold, but other elements related mineralization is low and mineralization has not been observed. Therefore, the sample are not interpreted as anomalous.

The six (6) samples are firstly candidates for anomalies, which is higher than average + 1 x standard deviation. They are taken from the localities between Malang and Lumajang. However, Only the sample I206S(75ppm) shows high Au value(0.121ppm) and other samples do not show anomalous values.

The samples than taken form the localities where two or more rocks are underlain are termed as 'multi-lithology'. The multi-lithology samples higher 116ppm (average + 3 x standard deviation) are the candidates for anomalous. The 11 samples are the candidates. In the west area, the samples at Selogiri（G042S：294ppm) and south of Klaten(I107S：120ppm）are anomalous. The sample G042S show high Au value, therefore, are interpreted to be anomalous, related to mineralization. However, the sample of south of Klaten does not show high in other elements.

On the other hand, between Malang and Lumajang, eight (8) samples (I243S, I226S, I227S, L265S, L263E, L248E, I253S and I251S show between 116 and 134ppm, but low in other elements related mineralization.

[Pb]

Samples higher than 81ppm (average + 2 x standard deviation) is determined to be anomalous in the Tertiary Volcanic rock area. Two (2) samples are interpreted to be anomalous:

(1) Selogiri: A041S(296ppm)

(6) Purwodadi: H239E(96ppm)

One sample higher than 21ppm (average + 2 x standard deviation) is determined to be anomalous in the Tertiary Pyroclastic rock area:

(9) Purworejo: K205E(64ppm).

The sample shows also Au anomaly and are interpreted to be related with mineralization.

Four (4) samples higher than 19 ppm (average + 2 x standard deviation) are candidates for anomalies in the 'Sedimentary rock' area. The samples are taken form the West Area (L014S, L058E, .L52S, L044S) and show between 18 and 23ppm Pb. Values in other elements related mineralization are low and are not interpreted to be geochemical anomaly, while Mo value in one sample show 1.57ppm.

Two (2) samples higher than 67 ppm (average + 2 x standard deviation) are candidates for anomalies in the 'Limestone' area. The two samples (H061S: 82ppm, H064S: 292ppm) are located near Wonosari in the West Area. The values of elements such as Zn are high, and the samples are interpreted to be geochemical anomalies.

One sample higher than 20 ppm (average + 2 x standard deviation) is determined to be anomalous in the 'Quaternary volcanic rock' area:J051S (25ppm）. The sample show high values (181ppm) in Zn, and is interpreted to be geochemical anomaly.

Thirteen (13) samples higher than 38 ppm (average + 2 x standard deviation) are candidates for anomalies in the 'Limstone' area. Among the samples, five (5) samples show higher than 52 ppm (average + 3 x standard deviation). The two samples at Selogiri (G042S: 61ppm, G040S: 58ppm) are located in the West Area. The three samples south of Tulungagung (L121E, 63ppm), south of Malang (J266E:417ppm) and Purwoharjo (L248S:69) are interpreted to be geochemical anomalies since Sn-Sb, Zn and Zn-Bi values are high, respectively.

[As]

Six (6) samples higher than 35 ppm (average + 2 x standard deviation) are candidates for anomalies in the 'Tertiary volcanics' area. One sample (G041S:90ppm) are located at Selogiri in the West Area. Three samples (I076S:85ppm, I078S:60ppm, K094S:60ppm), in the Sentul East district, south of Tulungagung, and two samples ((I213S:40ppm, G223S:49ppm)) near Purwodadi are interpreted to be geochemical anomalies since Au and/or Sb values are high.

Ten (10) samples higher than 6.4 ppm (average + 2 x standard deviation) are candidates for anomalies in the 'Tertiary volcaniclastics' area. Two samples (J118：6.4ppm, J119:7.4ppm), west of Tulungagung district, One sample (H116E: 9.4ppm) in Sentul East south of Tulungagung, five(5) samples (J198E:9.8ppm, J200E:7.4ppm, J187E:9.2ppm, J173:6.5ppm, L167E:8.9ppm) from Ringingrejo district and three samples (J259E: 7.4ppm, K210S:6.6ppm, I233S:6.5ppm) south Malang are the candidates. However, only J118S and J119E are interpreted to be geochemical anomalies since other elements related mineralization such as Zn and Cd values are high, whereas other samples are not geochemical anomalies related to mineralization.

Three (3) samples higher than 10 ppm (average + 2 x standard deviation) are candidates for anomalies in the 'Sedimentary rock' area. All of them are taken from the West district (L040S:15.6ppm, K015S:15.0ppm, K017S:10.9ppm), but other elements related to mineralization are so low that they are not interpreted to be anomalies related to mineralization.

Four (4) samples higher than 23.5 ppm (average + 2 x standard deviation) are candidates for anomalies in the 'limestone' area. They are taken from the limestone area between Tulungagung and Malang (I134E:27.3ppm, I131S:24.1ppm, I129S:24.9ppm, I197S:29.6), but other elements related to mineralization are so low that they are not interpreted to be anomalies related to mineralization.

One (1) sample higher than 1.18 ppm (average + 2 x standard deviation) is a candidate for anomalies in the 'Quaternary' area. It was taken from Prambon district (H092S:12.8ppm), but other elements related to mineralization are so low that they are not interpreted to be anomalies related to mineralization.

Twenty-two (22) samples higher than 34 ppm (average + 2 x standard deviation) are candidates for anomalies in the 'multi-rocks areas' area. Among them, five(I107S, I106S, I109E, I108S, I082S) from the west of Tulungagung show 34-58ppm, but they are suspected to be unrelated to mineralization. In the Sentul East district and to east of it, six(6) samples (K097S, 40ppm, K088S:40ppm, K098E:36ppm, G069S:49ppm, G075S:34ppm, G074S:39ppm) are the candidates. Among these, The sample K097S shows high S, Se and Te values. The samples K088S and K098E show high Au values, and the sample G075S and K074S show high Mo and Sb values. From south to southeast of Blitar, ten(10) samples (I136S:35ppm, I184S:35ppm, . I135E:39ppm, . I196E:63ppm, G178E:42ppm, G159:34ppm, I191:70ppm, I176S:37ppm, G147E:73ppm and L159E:40ppm), and in the Purwodadi district one sample (I207S:35ppm) show high As values, but other elements related to mineralization are low.

[Sb]

The following samples located in the districts show anomalous antimony values.

(1) Selogiri district:G041S(1.29ppm), J065S(1.86ppm)

(2) Prambon district to (4) Sentul East: L093S(1.11ppm), I105E(0.91ppm), I107S(2.27ppm), I108S(1.50ppm), I070S(.920ppm), I076S(1.77ppm), I078S(1.06ppm), K094S(1.32ppm), K076S(1.321pm), K077S(1.50S), G069S(1.15ppm), G076S(1.14ppm), G075S(2.84ppm)

(6) Purwodadi district and to north of the district: I247S(3.23ppm), G223S(1.22ppm), G202S(3.24ppm), G184S(1.12ppm)

- Wonosari: H061S(1.15ppm), H064S(3.45ppm), H054S(1.00ppm), H011S(0.90ppm)
- Ringinrejo, east of Blitar: G176E(3.23ppm)

[Hg]

One sample G041S from the (1) Selogiri district are designated as geochemical anomaly within the 'Tertiary Andesite' area.　The sample show 5.63ppm Hg, and 7.4ppmAu.

Three samples that show higher than 0.047ppm Hg (average + 2 x standard deviation) are selected as candidates for geochemical anomalies within the Tertiary volcaniclastics'.

(6) Purwodadi district:（K205E:0.05ppm), （L266E：0.05ppm）and（L253E:0.05ppm)

The sample K205E shows high Au value, consequently is are assumed to be a geochemical anomaly, whereas the other two samples do not show high values of elements related to mineralization. Therefore, the Hg values of samples L266E and L253E do not appear to reflect mineralization.

Three samples are exceeding 0.032ppm in Hg (average + 2 x standard deviation) within the 'Shale' area.　All of the three samples are taken from the West area（K029S:0.050ppm, K015S:0.040ppm, L014S:0.040ppm).　However, the other elements related to mineralization do not show high values, the localities are not assumed to be geochemical anomalies.

One sample exceeding 0.6 ppm (average + 2 x standard deviation) is the only one candidate for anomalies in the 'limestone' area.　The sample H013E was taken from the West area and show3.38ppm. The sample shows 0.049ppm Au and thought to be high for geochemical anomaly.

Two samples exceeding 0.61 ppm (average + 2 x standard deviation) are candidates for anomalies in the 'Quaternary' area.　The samples J102S(0.10ppm) and J213(0.080ppm) were taken from the Tulungagung district, in the West area.　But the samples do not show high values in the elements related to mineralization, and are not thought to be high for geochemical anomaly.

Five (5) samples higher than 0.43 ppm (average + 2 x standard deviation) are candidates for anomalies in the 'multi-rocks ' area. Among them, four(J079S:1.01ppm, J064S:0.47ppm, G037S:1.37ppm, G042S:6.49ppm) from the West area, and one (L148S:0.83ppm) from the (8) Ringinrejo（L148S:0.83ppm）. All samples except J079S show high Au values.

[Mo]

Six (6) samples exceeding 1.86 ppm (average + 3 x standard deviation) are candidates for anomalies in the 'Andesite' area.

(2) Prambon district (G089S:2.28ppm)

(4) Sentul East(I072S:2.35ppm, I076S:2.36ppm)

(5) Seweden district(H136S:2.39ppm)

(6) Purwodadi district and surrounding areas (J244S:2.14ppm, I216S:2.35ppm)

Among them, the sample G089S show high Bi values at1.24ppm, but other elements are low values for all samples.

Five (5) samples exceeding 1.28 ppm (average + 2 x standard deviation) are candidates for anomalies in the 'Tertiary volcaniclastics' area. In (8) Ringinrejo district to southeast of Blitar, the samples (J198:1.73ppm), (L167E：1.80ppm) and (J187E:1.52ppm) show high Mo values. But they are low in other elements related to mineralization. They are not thought to be geochemical anomaly.

Five (5) samples exceeding 1.46 ppm (average + 2 x standard deviation) are candidates for anomalies in the 'Shale' area. The samples (K054S:2.46ppm, K053S:1.63ppm, H043S:2.11ppm, L040E:1.46ppm and J044E:1.57ppm) are taken from the West area. But they are low in other elements related to mineralization. They are not thought to be geochemical anomaly.

Three (3) samples exceeding 4.4 ppm (average + 2 x standard deviation) are candidates for anomalies in the 'Limestone' area. They are taken from

(2) Prambon(L094E:4.4ppm)

(5) Seweden(H196E:17.75ppm)

(6) Purwodadi(J234E:4.96)

Only As (arsenic) of H196E is as high as21.2ppm. But the other two samples are low in the elements related to mineralization and are not thought to be geochemical anomaly.

One sample exceeding 1.18 ppm (average + 2 x standard deviation) is the only one candidate for anomalies in the 'Quaternary' area. The sample I064S was taken from the West area and show1.38ppm.　The sample does not show high values in other elements related mineralization, and the high Mo value are not thought to be geochemical anomaly.

Three (10) samples exceeding 2.94 ppm (average + 3 x standard deviation) are candidates for anomalies in the ' multi-rocks ' area.　One sample (J024E：3.53ppm) were taken from the West area. Other samples are taken from

(4) Sentul East(K091E:3.09ppm)

- South of Tulungagung (G076S:3.70ppm, G075S:6.54ppm, G074S:5.32ppm, J156E:3.42ppm, J149E:3.27ppm)
- South- southeast of Blitar (K130E:3.62ppm, H162S:7.64ppm, K179E:3.08ppm and I158S:4.26ppm)

They show high As (arsenic) values, while the other elements related to mineralization are.

[Zn]

Two (2) samples exceeding 269 ppm (average + 2 x standard deviation) are determined for geochemical anomalies in the 'Tertiary Andesite' area.　They are taken from

(1) Selogiri district (A041S:781 ppm)

(6) Purwodadi district (H299E:477 ppm)

They are thought to be geochemical anomaly as other elements related to mineralization are also high.

Two (2) samples exceeding 228 ppm (average + 2 x standard deviation) are determined for geochemical anomalies in the 'Tertiary volcaniclastics' area.　They are taken from

(2) Prambon district: J119(240ppm). It shows high sulfur as high as0.25%S, and indicates the relation with mineralization.

(4) Ringinrejo district:L164E(250ppm). It might not be geochemical anomaly as other elements related to mineralization are low.

Four(4) samples exceeding 151ppm (average + 2 x standard deviation) are determined for geochemical anomalies in the 'Shale' area.　They are K006S(152ppm), I022S(152ppm), I010S(153ppm), H048S(154ppm) taken from the West area.

They might not be geochemical anomaly as other elements related to mineralization are low.

Nine (9) samples exceeding 226 ppm (average + 2 x standard deviation) are determined for geochemical anomalies in the 'limestone' area.　They are taken from

And - Wonosari district: (H061S:82ppm, H064S：292ppm）.They are high in Pb and other elements,

and indicates the relation with mineralization.
On contrary, other samples taken from
- South to southeast of Tulungagung (J147E:234ppm)
- Southeast of Seweden (G156E:270ppm, G167E:250ppm, G165:269ppm)
- Southeast of Ringinrejo (L204S:289ppm, L203S:319ppm, L201S:248ppm).
They do not show high values in the elements related to mineralization.

Nine (9) samples exceeding 226 ppm (average + 2 x standard deviation) are determined for geochemical anomalies in the 'limestone' area. They are taken from
And - Wonosari district: (H061S:82ppm, H064S：292ppm）.They are high in Pb and other elements, and indicate the relation with mineralization.
On contrary, other samples taken from
- South to southeast of Tulungagung (J147E: 234ppm)
- Southeast of Seweden (G156E:270ppm, G167E:250ppm, G165:269ppm)
- Southeast of Ringinrejo (L204S:289ppm, L203S:319ppm, L201S:248ppm).
They do not show high values in the elements related to mineralization.

Six (6) samples exceeding 202 ppm (average + 1 x standard deviation) are determined for candidates for geochemical anomalies in the 'Quaternary' area. They are taken from
- One sample I206S(219ppm) from Ringinrejo districts thought to show the geochemical anomaly since the Au value is as high as 121ppb. But,
- Two samples from the west of Tulungagung: J100S(208ppm) and J102S(264ppm)
- Three samples from the Ringinrejo district:J213S(208ppm), I204S(266ppm) and L185S(215ppm) do not show high values in other elements related to mineralization.

Fourteen (14) samples exceeding 202 ppm (average + 2 x standard deviation) are determined for candidates for geochemical anomalies in the 'Multi-rocks' area. They are taken from
(1) Selogiri (G064S：316ppm, G030S：318ppm, G001S:304ppm)
(2) East of 'Sentul East' district (K084E:438ppm, K081S:508ppm, J148E:316ppm, J143E:332ppm)
(7) Southeast of Ringinrejo (L175E:315ppm, L173ppm:347ppm, J266E：496ppm, J239S:336ppm, J239S:336, J237S:318ppm)
(6) Purwodadi district (J299S:460ppm, J301E:688ppm)
Among those, the samples ofJ064S, G001S, K081S, J266E, J239S and J401S are defined to be anomalies since they show high values in Au and other elements related to mineralization.

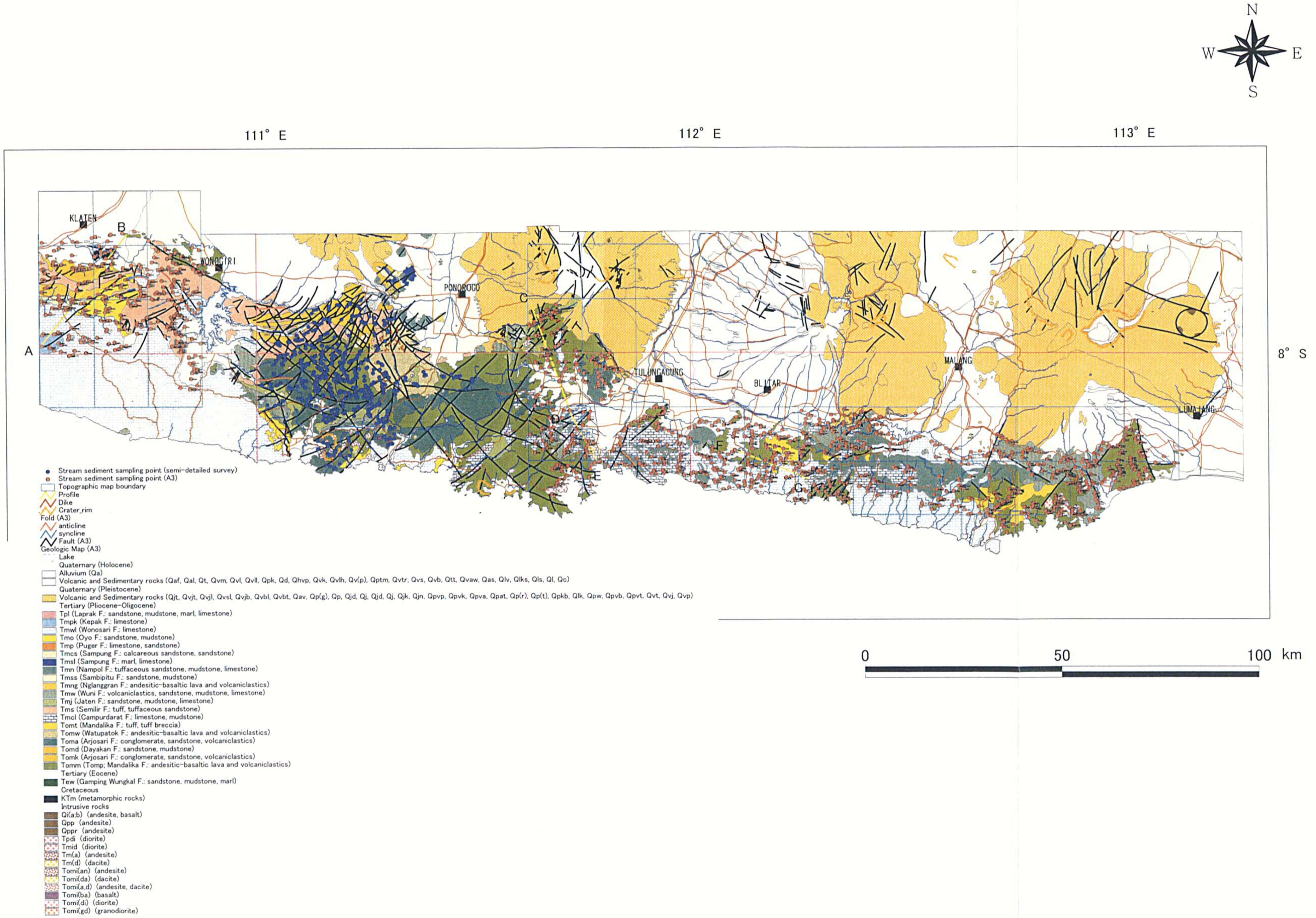
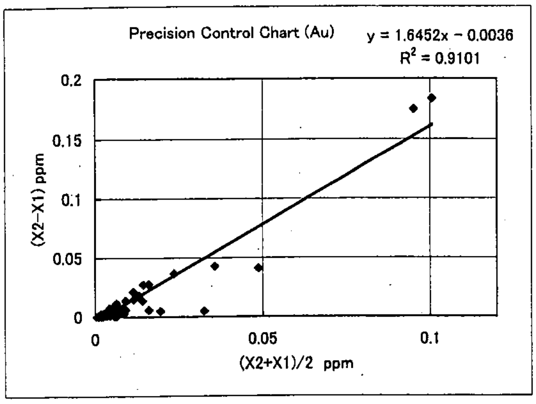
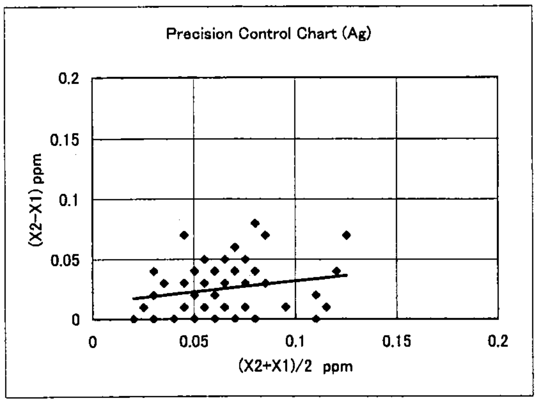
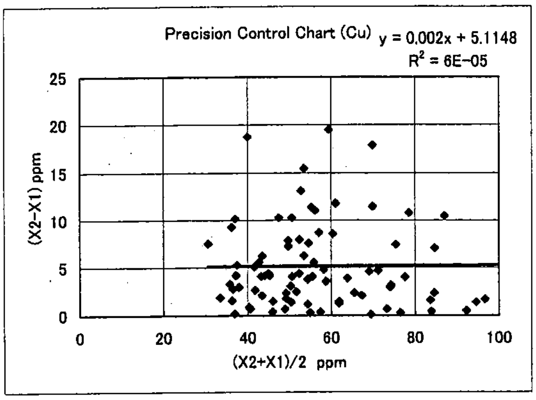
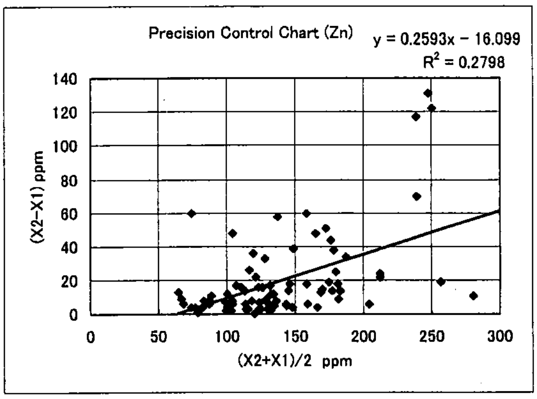


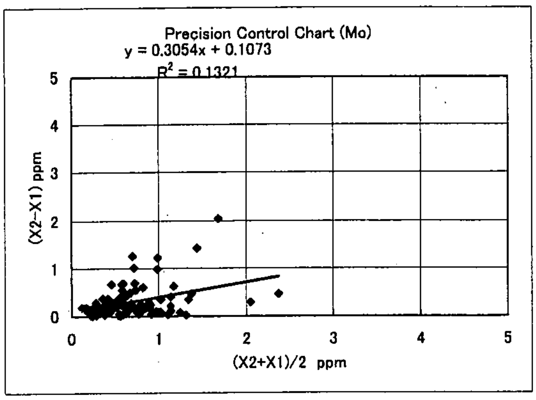
Fig. 3-18 Location Map of Stream Sediment Samples











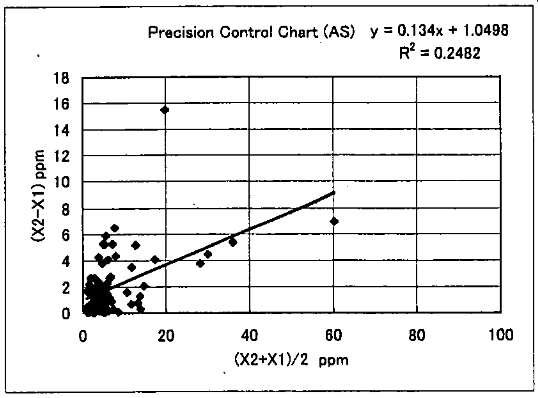


Fig. 3-19 Sampling Error of Stream Sediments

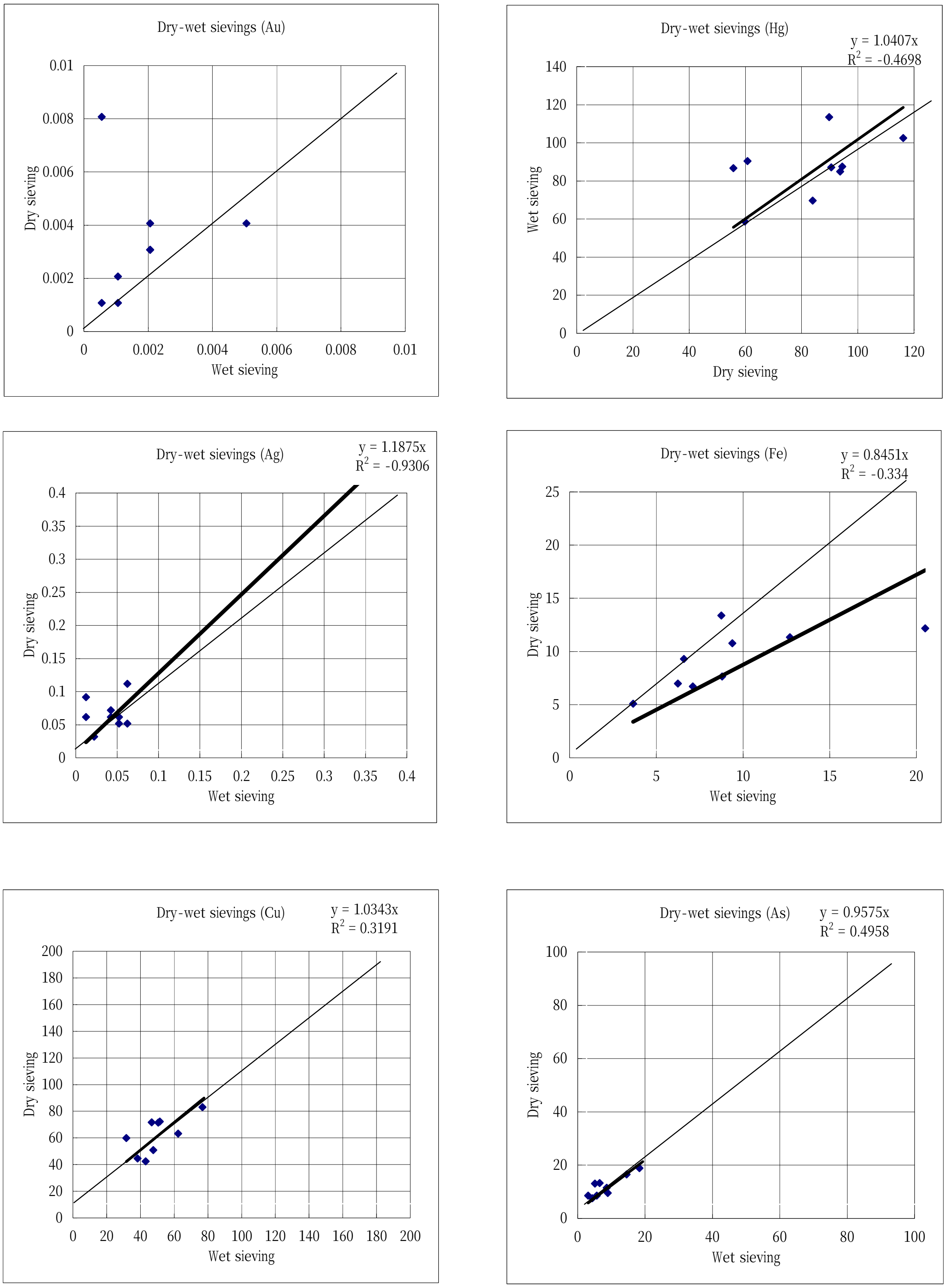


Fig. 3-20 Comparison of Sampling Methods of Stream Sediments (1/3)

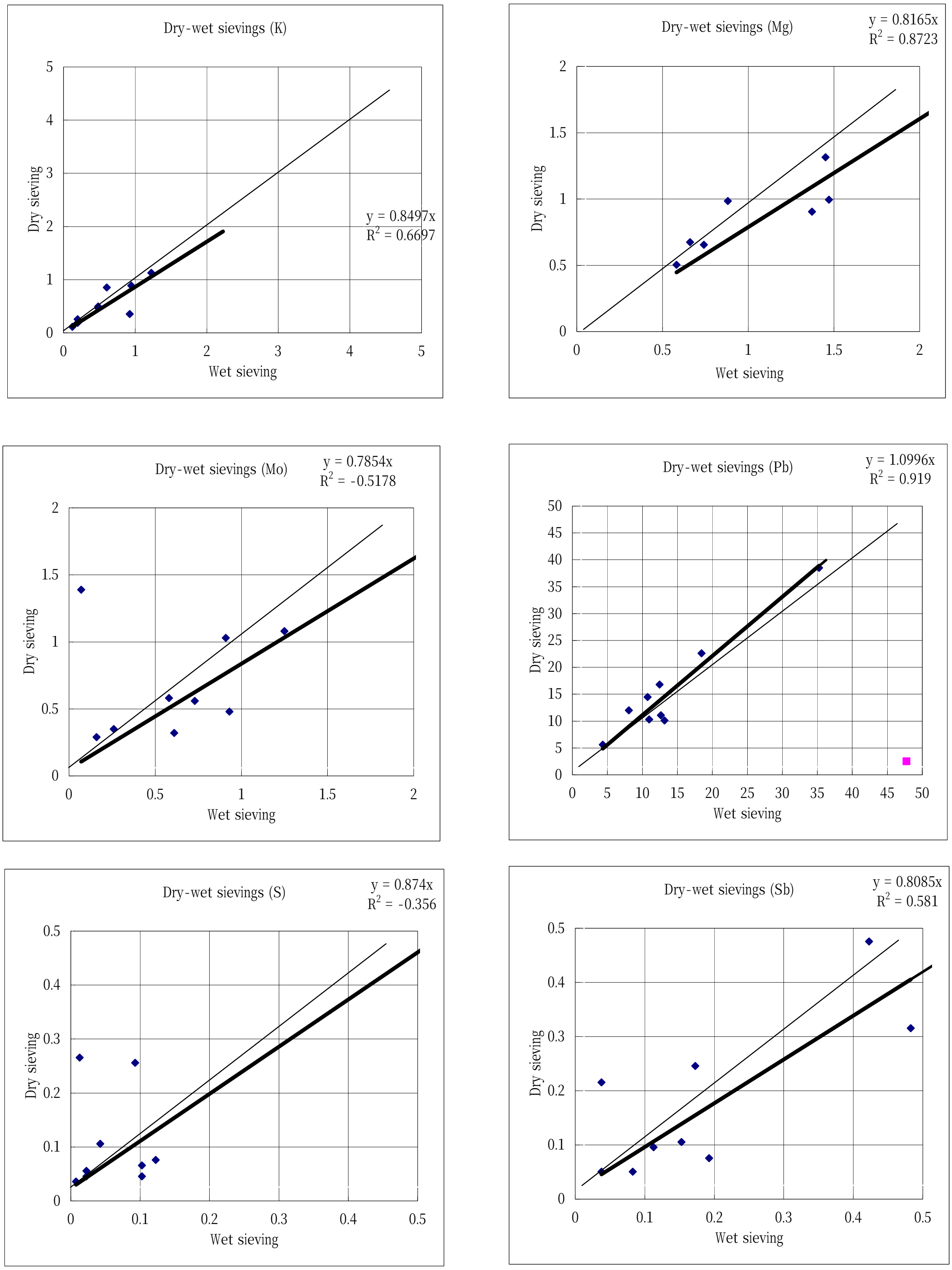


Fig. 3-20 Comparison of Sampling Methods of Stream Sediments (2/3)

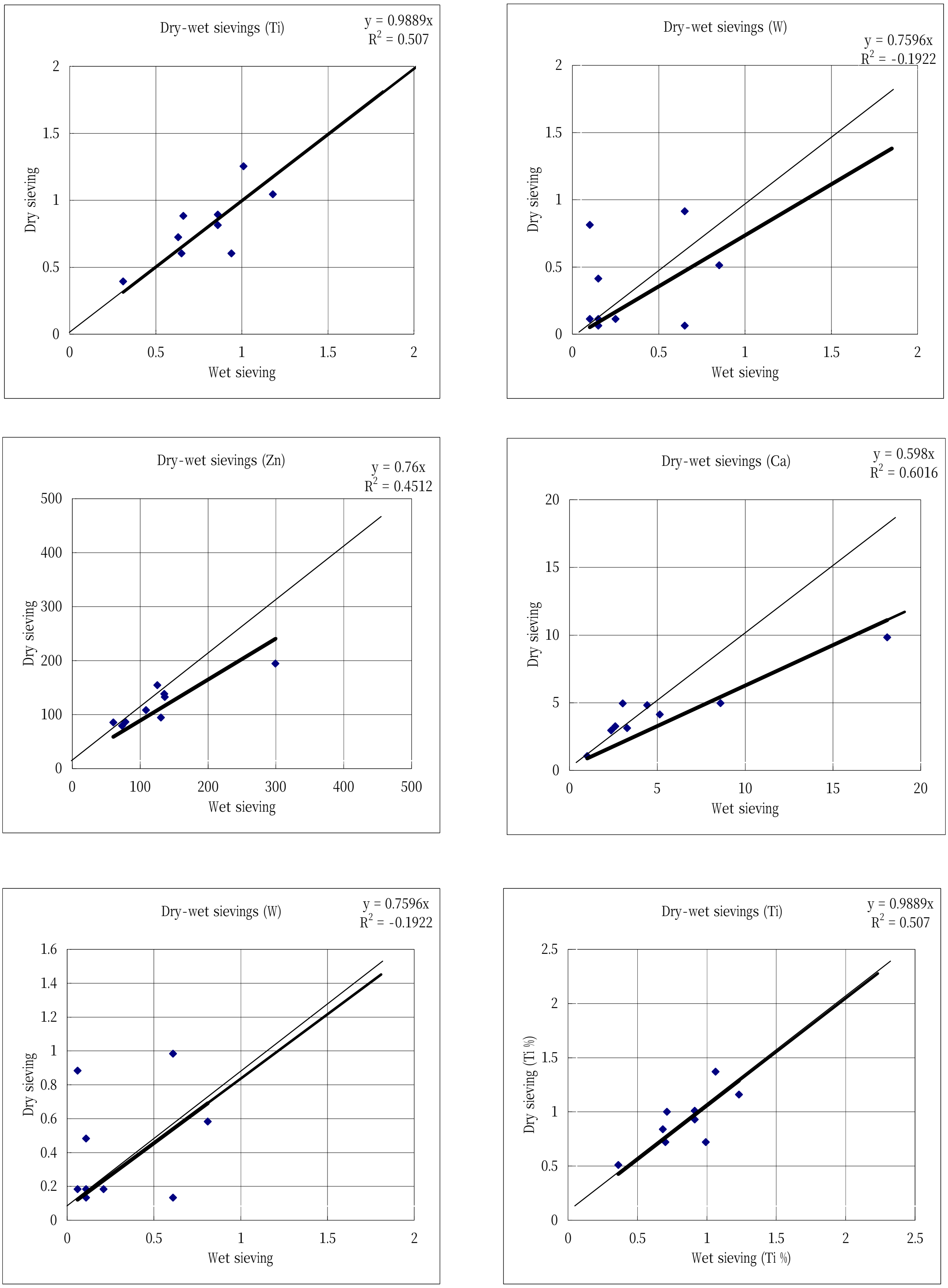


Fig. 3-20 Comparison of Sampling Methods of Stream Sediments (3/3)

Table 3-9 Statistic Data of Geochemical Analysis

Element	Au	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	In	K	La	Li	Mg	Mn	Mo
Unit	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm
n	1660	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661
average	**0.02**	**0.07**	**8.55**	**8**	**275**	**0.66**	**0.13**	**3.55**	**0.17**	**25**	**37**	**48**	**1.3**	**56**	**9.79**	**21**	**0.32**	**2.2**	**0.09**	**0.36**	**10.4**	**13.1**	**1.00**	**1,787**	**0.83**
S.D.	0.19	0.14	1.70	12	147	0.18	0.12	3.94	0.18	13	15	42	0.6	21	4.41	5	0.12	0.6	0.03	0.22	4.3	5.1	0.41	824	0.79
min	0.00	0.01	0.92	0.1	15	0.03	0.01	0.13	0.03	5	4	2	0.1	15.0	0.63	4	0.03	0.5	0.00	0.01	2.7	1.6	0.10	126	0.03
max	**7.40**	**4.62**	**14.95**	**326**	**2,080**	**1.51**	**1.80**	**25.00**	**3.61**	**143**	**127**	**569**	**9.8**	**294**	**25.00**	**44**	**0.83**	**4.9**	**0.50**	**1.42**	**43.2**	**48.9**	**3.83**	**9,840**	**17.75**
average+S.D.	0.21	0.21	10.25	20	422	0.84	0.26	7.49	0.36	38	52	91	1.9	77	14.20	26	0.44	2.8	0.11	0.58	14.7	18.2	1.42	2,610	1.62
average+2XS.D.	0.40	0.35	11.95	31	570	1.03	0.38	11.43	0.54	51	68	133	2.4	99	18.61	31	0.56	3.5	0.14	0.81	19.0	23.4	1.83	3,434	2.42
average+3XS.D.	0.59	0.49	13.65	43	717	1.21	0.50	15.38	0.73	64	83	175	3.0	120	23.03	35	0.68	4.1	0.17	1.03	23.2	28.5	2.24	4,258	3.21

S.D.: standard deviation

References

Phase 1 average(817 samples)	0.004	0.25	2.04	4.65	92.1	0.36	8.76	0.704	0.65		22.5	35.7		33	8.48					0.086			0.585	1,270	0.600
Average amount in Crustal Rocks (Mason, B and Moore,C.B.; 1982)																									
Crustal Average	0.004	0.07	8.13	1.8	425	2.8	0.2	3.63	0.2	60	25	100	3	55	5	15	1.5	3	0.1	2.59	30	2.8	2.09	950	1.5
Granite(G-1)	0.004	0.05	7.43	0.5	1,220	3.0	0.07	0.99	0.03	170	2.4	20	1.5	13	1.37	20	1.1	5.2	0.02	4.51	101	3	0.24	195	6.5
Diabase(W-1)	0.004	0.08	7.94	1.9	160	0.8	0.08	7.83	0.15	23	47	114	0.9	110	7.76	16	1.4	2.7	0.07	0.53	9.8	0.8	3.99	1280	0.57

Element	Ni	Nb	Ni	P	Pb	Rb	Re	S	Sb	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr	Hg
Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
n	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661.0	1661	1661	1661	1661	1661	1661
average	**17**	**2**	**17**	**412**	**13**	**11.8**	**0.002**	**0.05**	**0.19**	**1.8**	**1.0**	**179**	**0.08**	**0.07**	**2.7**	**0.73**	**0.20**	**0.8**	**399**	**0.25**	**18**	**130**	**76**	**0.03**
S.D.	11	1	11	199	33	6.2	0.001	0.13	0.34	0.9	2.6	89	0.07	0.09	1.2	0.27	0.10	0.4	231	0.21	4	57	23	0.23
min	0.1	0	0	10	2	0.3	0.001	0.01	0.03	0.5	0.1	8	0.03	0.03	0.5	0.03	0.01	0.2	14	0.05	4	13	15	0.01
max	**121**	**7**	**121**	**2,800**	**1,185**	**52.1**	**0.024**	**1.94**	**9.29**	**7.0**	**77.6**	**704**	**0.43**	**1.63**	**8.9**	**2.21**	**1.12**	**4.5**	**1,750**	**1.30**	**37**	**781**	**158**	**6.49**
average+S.D.	28	3	28	612	45	17.9	0.003	0.18	0.53	2.7	3.6	268	0.16	0.16	4.0	1.00	0.29	1.3	630	0.45	23	187	99	0.26
average+2XS.D.	39	4	39	811	78	24.1	0.005	0.32	0.88	3.6	6.2	357	0.23	0.25	5.2	1.27	0.39	1.7	862	0.66	27	244	122	0.49
average+3XS.D.	49	5	49	1,010	111	30.2	0.006	0.45	1.22	4.5	8.8	445	0.30	0.35	6.4	1.55	0.49	2.1	1,093	0.87	31	301	145	0.72

S.D.: standard deviation

References

Phase 1 average(817 samples)	12.2	0	12.2	180	8.5	0	0.000	0.0	2.51	0	0.0	59.67	0	0	0	0.351	0	0	367	5	0	121	0.0	0.018
Average amount in Crustal Rocks (Mason, B and Moore,C.B.; 1982)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustal Average	75	20	75	1050	13	90	0.001	0.026	0.20	0.05	2	375	0	0.01	7.2	0.44	0.5	1.8	135	1.5	33	70	165	0.08
Granite(G-1)	1	24	1	390	48	220	<0.002	0.0058	0.31	0.007	3.5	250	0	<1	50	0.15	1.2	3.4	17	0.4	13	45	210	0.1
Diabase(W-1)	76	9.5	76	610	7.8	21	<0.002	0.0123	1.0	0.3	3.2	190	0	<1	2.4	0.64	0.11	0.58	264	0.5	25	86	105	0.2

Table 3-10 Statistic Data of Geochemical Analysis Classified by Geologic Units

Formation	Statisitics	Au	Ag	Al (%)	As	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm
Mandalika Formation															
Tomt (volcaniclastics)	number	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	average	0.0014	0.074	7.95	4.62	317	0.75	0.11	1.76	0.18	24.89	30.1	23.5	1.37	45
	standard deviation	0.0009	0.014	0.92	1.60	68	0.07	0.05	0.39	0.14	5.86	10.2	13.6	0.32	9
Mandalika Formation															
Tomm	number	157	157	157	157	157	157	157	157	157	157	157	157	157	157
	average	0.0150	0.096	8.91	9.68	221	0.62	0.16	1.52	0.22	19.69	31.2	49.2	1.40	57
	standard deviation	0.0611	0.367	1.22	13.78	76	0.13	0.20	0.73	0.30	4.79	10.1	40.6	0.71	19
Kebobutak Formation															
Tomk	number	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	average	0.0040	0.049	7.90	2.94	181	0.64	0.08	3.50	0.11	17.14	22.5	26.7	0.95	70
	standard deviation	0.0071	0.020	0.38	0.96	58	0.07	0.04	1.83	0.02	2.18	2.3	16.0	0.26	7
Intrusive (diorite)															
Tomi(di)	number	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	average	0.0028	0.070	8.39	5.15	147	0.60	0.27	0.88	0.48	19.95	34.8	48.0	0.88	55
	standard deviation	0.0025	0.057	0.28	0.92	16	0.03	0.25	0.06	0.39	5.16	22.2	36.8	0.27	1
Arjosari Foramation															
Toma	number	8	8	8	8	8	8	8	8	8	8	8	8	8	8
	average	0.0091	0.116	7.89	5.06	185	0.52	0.21	1.39	0.62	16.93	31.9	35.4	1.28	68
	standard deviation	0.0084	0.039	0.88	2.34	32	0.09	0.16	0.57	0.71	2.15	5.5	12.5	0.33	15
Wonosari Formation															
Tmwl	number	131	131	131	131	131	131	131	131	131	131	131	131	131	131
	average	0.0113	0.062	7.98	10.63	364	0.71	0.15	8.10	0.18	37.72	37.6	37.3	1.08	52
	standard deviation	0.0406	0.063	2.06	6.59	276	0.27	0.08	6.06	0.08	27.66	17.5	31.2	0.31	17
Wuni Fromation															
Tmw	number	56	56	56	56	56	56	56	56	56	56	56	56	56	56
	average	0.0151	0.059	10.70	4.32	408	0.75	0.11	1.67	0.15	28.38	47.7	53.9	1.31	95
	standard deviation	0.0920	0.019	2.05	1.85	128	0.15	0.05	1.10	0.04	8.72	10.2	51.6	0.28	34
Semilir Formation															
Tms	number	74	74	74	74	74	74	74	74	74	74	74	74	74	74
	average	0.0023	0.045	9.70	5.11	211	0.80	0.13	1.59	0.12	23.90	28.1	39.7	1.36	42
	standard deviation	0.0024	0.022	1.25	2.78	73	0.12	0.05	1.84	0.05	4.98	7.5	30.8	1.06	12
Kepek Formation															
Tmpk	number	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	average	0.0026	0.073	7.39	4.00	378	0.87	0.21	11.71	0.26	54.43	31.0	30.0	1.87	40
	standard deviation	0.0005	0.029	0.91	1.75	22	0.20	0.06	3.01	0.01	1.82	4.4	11.0	0.84	6
Oyo Formation															
Tmo	number	14	14	14	14	14	14	14	14	14	14	14	14	14	14
	average	0.0029	0.086	8.22	5.21	227	0.76	0.18	8.99	0.15	31.71	23.6	23.9	1.39	41
	standard deviation	0.0013	0.032	2.30	2.26	42	0.28	0.06	6.68	0.06	8.92	6.3	9.9	0.46	11
Nglanggran Formation															
Tmng	number	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	average	0.0082	0.027	10.71	4.30	207	0.85	0.11	0.92	0.09	22.83	41.9	54.7	1.25	91
	standard deviation	0.0120	0.015	0.89	1.37	12	0.09	0.03	0.17	0.03	2.23	4.6	17.2	0.33	13
Nampol Formation															
Tmn	number	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	average	0.0033	0.066	8.77	5.66	380	0.70	0.10	2.40	0.16	28.04	50.7	63.5	1.31	71
	standard deviation	0.0047	0.019	1.36	1.57	88	0.12	0.03	1.31	0.03	6.57	14.0	54.8	0.23	13
Jaten Formation															
Tmj	number	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	average	0.0068	0.030	8.72	4.85	193	0.69	0.07	1.38	0.13	21.50	24.9	43.0	1.70	42
	standard deviation	0.0088	0.014	0.28	3.32	4	0.08	0.02	0.42	0.05	0.99	1.6	26.9	0.78	7
Campurdarat Formation															
Tmcl	number	20	20	20	20	20	20	20	20	20	20	20	20	20	20
	average	0.0051	0.078	8.63	9.49	335	0.67	0.11	4.05	0.17	29.63	49.8	52.3	1.20	62
	standard deviation	0.0077	0.029	1.54	6.17	112	0.19	0.03	4.35	0.05	11.49	22.0	31.8	0.39	15
Quaternary															
Qv,Qa	number	35	35	35	35	35	35	35	35	35	35	35	35	35	35
	average	0.0213	0.077	8.24	3.87	363	0.58	0.08	2.97	0.12	21.55	41.3	35.3	1.49	54
	standard deviation	0.0501	0.109	1.29	2.38	111	0.16	0.04	1.63	0.02	7.68	15.5	20.6	0.75	16
Others															
	number	1,125	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126
	average	0.0098	0.070	8.41	8.36	267	0.65	0.13	3.49	0.17	23.82	37.1	50.8	1.26	55
	standard deviation	0.0401	0.098	1.63	12.69	131	0.18	0.12	3.64	0.18	11.16	15.9	44.4	0.56	20

Formation	Statisitics	Fe	Ga	Ge	Hf	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb
		%	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	$	ppm	ppm	ppm	ppm
Mandalika Formation																	
Tomt (volcaniclastics)	number	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	average	8.31	19.33	0.20	2.64	0.08	0.54	10.44	10.61	0.78	1,635	0.37	0.81	0.97	10.91	325	11.98
	standard deviation	2.61	2.55	0.04	0.39	0.01	0.20	1.60	1.01	0.21	293	0.16	0.18	0.44	4.66	100	6.64
Mandalika Formation																	
Tomm	number	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157
	average	8.65	20.13	0.27	2.06	0.09	0.50	8.53	11.25	1.07	1,574	0.65	0.81	1.51	16.09	404	12.50
	standard deviation	2.69	3.02	0.08	0.58	0.03	0.21	1.78	3.97	0.32	341	0.49	0.42	0.90	8.47	144	24.47
Kebobutak Formation																	
Tomk	number	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	average	6.02	16.93	0.37	2.44	0.07	0.76	7.53	13.86	1.33	1,241	0.52	0.97	1.33	13.23	454	7.09
	standard deviation	0.77	1.15	0.04	0.15	0.01	0.10	1.16	1.67	0.30	143	0.15	0.31	0.34	2.22	101	1.01
Intrusive (diorite)																	
Tomi(di)	number	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	average	9.51	22.30	0.34	1.95	0.13	0.27	8.10	9.45	1.21	1,664	0.81	1.05	1.75	20.35	490	12.20
	standard deviation	5.69	4.81	0.21	0.92	0.04	0.18	1.27	2.76	0.15	218	0.24	1.23	0.35	13.36	71	0.28
Arjosari Foramation																	
Toma	number	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
	average	9.85	18.44	0.29	1.65	0.09	0.44	7.65	7.14	0.97	1,642	0.77	0.71	1.75	13.13	369	10.94
	standard deviation	1.78	1.22	0.07	0.35	0.02	0.11	0.80	0.56	0.24	382	0.25	0.19	0.33	3.33	49	3.38
Wonosari Formation																	
Tmwl	number	131	131	131	131	131	131	131	131	131	131	131	131	131	130	131	131
	average	8.26	18.45	0.26	2.23	0.08	0.20	15.04	15.17	0.70	2,414	1.36	0.41	2.87	12.32	434	17.26
	standard deviation	3.75	5.39	0.12	0.68	0.02	0.14	8.29	5.33	0.34	1,798	1.65	0.38	1.61	7.69	313	26.96
Wuni Fromation																	
Tmw	number	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
	average	11.79	24.94	0.35	2.62	0.10	0.28	12.05	11.06	0.94	1,972	0.48	0.56	1.14	23.14	506	11.12
	standard deviation	2.94	3.75	0.10	0.60	0.02	0.11	3.09	1.97	0.50	384	0.31	0.29	0.84	12.15	160	7.77
Semilir Formation																	
Tms	number	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74
	average	7.96	22.76	0.36	2.95	0.09	0.32	10.12	17.64	0.96	1,298	0.66	0.44	1.75	15.01	389	10.76
	standard deviation	1.85	3.09	0.07	0.55	0.02	0.17	1.71	4.24	0.32	415	0.42	0.24	0.82	9.27	77	2.55
Kepek Formation																	
Tmpk	number	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	average	5.13	14.93	0.25	2.08	0.07	0.20	20.60	19.83	0.79	2,769	0.48	0.43	3.95	10.08	493	20.08
	standard deviation	1.69	2.81	0.07	0.31	0.02	0.04	0.65	5.50	0.15	624	0.13	0.16	0.84	9.52	19	2.16
Oyo Formation																	
Tmo	number	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
	average	4.87	17.84	0.32	2.35	0.07	0.12	15.34	18.67	0.55	1,332	0.71	0.18	3.34	10.56	270	14.17
	standard deviation	1.30	5.60	0.09	0.84	0.02	0.06	4.05	7.28	0.17	439	0.36	0.08	1.27	7.19	77	4.37
Nglanggran Formation																	
Tmng	number	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	average	10.07	26.27	0.43	2.97	0.10	0.14	10.10	12.60	0.84	1,448	1.05	0.24	2.00	25.33	407	14.03
	standard deviation	1.15	1.38	0.06	0.15	0.00	0.01	1.42	2.20	0.10	137	0.30	0.07	0.50	5.58	129	2.28
Nampol Formation																	
Tmn	number	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	average	12.63	24.69	0.35	2.20	0.09	0.24	11.72	12.05	0.92	2,214	0.80	0.55	2.34	22.59	427	10.26
	standard deviation	4.44	3.97	0.11	0.43	0.02	0.05	2.39	3.50	0.26	496	0.40	0.15	1.32	8.12	115	1.74
Jaten Formation																	
Tmj	number	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	average	7.61	20.50	0.39	2.75	0.05	0.57	10.40	12.40	1.19	1,295	0.59	0.93	2.75	12.15	395	8.20
	standard deviation	0.31	0.85	0.04	0.07	0.00	0.27	0.57	2.26	0.02	113	0.13	0.34	0.35	6.29	134	1.56
Campurdarat Formation																	
Tmcl	number	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
	average	13.53	24.19	0.34	2.06	0.10	0.17	12.58	11.15	0.90	2,437	1.05	0.39	2.10	20.75	287	10.99
	standard deviation	5.72	6.51	0.16	0.68	0.03	0.04	4.56	2.32	0.35	704	0.84	0.12	1.35	10.09	80	2.99
Quaternary																	
Qv,Qa	number	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	34
	average	12.50	22.80	0.33	1.97	0.09	0.43	9.92	9.47	1.40	2,102	0.63	1.05	2.21	16.87	710	11.11
	standard deviation	5.60	4.35	0.12	0.52	0.02	0.33	3.15	2.43	0.55	640	0.27	0.66	1.18	8.47	542	4.26
Others																	
	number	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126
	average	10.08	21.26	0.33	2.18	0.09	0.37	10.03	13.05	1.03	1,751	0.84	0.66	1.80	18.17	403	11.31
	standard deviation	4.65	4.75	0.12	0.60	0.03	0.22	3.57	5.22	0.41	687	0.70	0.48	1.11	10.54	172	13.43

Formation	Statisitics	Rb	Re	S	Sb	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr	Hg
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Mandalika Formation																				
Tomt (volcaniclastics)	number	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	average	17.5	0.00	0.02	0.03	1.32	0.86	179	0.03	0.03	2.79	0.56	0.19	0.64	299	0.08	21.1	120	85.80	0.02
	standard deviation	4.9	0.00	0.01	0.03	0.56	0.19	33	0.00	0.01	0.58	0.19	0.06	0.07	144	0.05	2.9	45	10.11	0.01
Mandalika Formation																				
Tomm	number	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157	157
	average	15.0	0.00	0.07	0.16	1.65	0.90	140	0.06	0.11	2.11	0.67	0.19	0.57	359	0.20	18.2	137	69.16	0.06
	standard deviation	6.2	0.00	0.15	0.26	1.15	0.33	50	0.05	0.14	0.78	0.23	0.09	0.21	168	0.19	2.8	70	21.84	0.45
Kebobutak Formation																				
Tomk	number	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	average	19.6	0.00	0.01	0.14	1.93	0.87	403	0.06	0.03	1.84	0.60	0.14	0.46	234	0.19	19.0	91	81.10	0.01
	standard deviation	3.7	0.00	0.00	0.07	0.19	0.10	133	0.03	0.02	0.40	0.11	0.03	0.05	38	0.10	1.1	7	3.63	0.00
Intrusive (diorite)																				
Tomi(di)	number	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	average	7.2	0.00	0.03	0.15	1.50	1.00	85	0.08	0.14	1.65	0.81	0.13	0.50	416	0.20	19.6	198	63.55	0.02
	standard deviation	2.5	0.00	0.00	0.09	1.41	0.14	3	0.01	0.16	0.78	0.64	0.01	0.28	362	0.00	1.8	15	34.01	0.00
Arjosari Foramation																				
Toma	number	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
	average	13.1	0.00	0.12	0.21	2.31	1.20	129	0.09	0.26	1.63	0.77	0.15	0.41	428	0.24	14.9	179	59.90	0.01
	standard deviation	1.9	0.00	0.11	0.09	0.80	0.21	49	0.02	0.33	0.10	0.15	0.02	0.06	123	0.05	3.4	86	13.94	0.00
Wonosari Formation																				
Tmwl	number	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131
	average	8.0	0.00	0.06	0.35	1.91	1.64	192	0.14	0.06	3.59	0.66	0.28	1.18	323	0.41	19.6	106	77.67	0.05
	standard deviation	4.0	0.00	0.18	0.35	0.83	6.19	75	0.10	0.04	1.63	0.26	0.17	0.55	181	0.27	6.6	51	24.69	0.29
Wuni Fromation																				
Tmw	number	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
	average	9.9	0.00	0.02	0.06	1.25	0.79	167	0.05	0.05	3.76	0.74	0.20	0.86	486	0.11	18.3	139	90.97	0.03
	standard deviation	3.2	0.00	0.02	0.06	0.76	0.44	54	0.04	0.05	1.40	0.21	0.06	0.33	174	0.10	2.3	32	18.46	0.01
Semilir Formation																				
Tms	number	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74
	average	11.5	0.00	0.06	0.14	2.28	1.01	131	0.09	0.04	2.75	0.75	0.17	0.90	279	0.21	23.1	107	103.36	0.01
	standard deviation	4.2	0.00	0.23	0.09	0.75	0.22	69	0.06	0.02	0.73	0.19	0.06	0.21	109	0.15	3.5	20	16.94	0.01
Kepek Formation																				
Tmpk	number	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	average	11.9	0.00	0.05	0.40	2.13	1.23	415	0.24	0.08	5.60	0.47	0.23	1.20	176	0.69	19.0	73	74.43	0.01
	standard deviation	4.4	0.00	0.02	0.05	0.25	0.28	52	0.05	0.01	1.01	0.16	0.04	0.18	64	0.06	0.8	21	11.85	0.00
Oyo Formation																				
Tmo	number	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
	average	7.4	0.00	0.04	0.33	2.14	1.26	288	0.21	0.07	3.91	0.41	0.18	1.12	158	0.59	19.4	58	92.36	0.02
	standard deviation	3.3	0.00	0.02	0.13	0.53	0.92	125	0.09	0.02	1.24	0.12	0.06	0.32	46	0.25	4.9	18	28.82	0.01
Nglanggran Formation																				
Tmng	number	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	average	7.1	0.00	0.03	0.10	2.67	1.30	77	0.12	0.04	2.83	0.92	0.14	0.77	527	0.33	23.9	122	105.93	0.02
	standard deviation	1.6	0.00	0.02	0.08	0.58	0.17	4	0.04	0.02	0.40	0.10	0.03	0.21	75	0.15	1.3	7	11.63	0.02
Nampol Formation																				
Tmn	number	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	average	10.6	0.00	0.02	0.10	1.77	0.84	176	0.12	0.04	3.28	0.82	0.22	0.80	550	0.28	18.7	135	79.01	0.01
	standard deviation	2.2	0.00	0.01	0.09	1.01	0.30	38	0.08	0.03	0.64	0.26	0.06	0.37	244	0.18	3.0	47	16.35	0.01
Jaten Formation																				
Tmj	number	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	average	20.1	0.00	0.03	0.17	2.00	1.05	141	0.16	0.04	2.65	0.73	0.23	0.80	275	0.25	20.6	110	89.50	0.01
	standard deviation	8.8	0.00	0.01	0.09	0.00	0.21	1	0.01	0.02	0.07	0.06	0.06	0.00	33	0.07	1.8	0	1.41	0.00
Campurdarat Formation																				
Tmcl	number	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
	average	7.1	0.00	0.01	0.26	1.78	0.78	158	0.09	0.05	3.34	0.85	0.22	1.05	559	0.38	18.9	156	74.84	0.02
	standard deviation	1.9	0.00	0.01	0.24	0.70	0.41	46	0.08	0.03	1.17	0.23	0.08	0.47	271	0.25	4.8	74	24.34	0.01
Quaternary																				
Qv,Qa	number	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35
	average	14.0	0.00	0.03	0.13	2.00	1.02	288	0.09	0.03	3.04	0.85	0.16	0.65	524	0.26	14.5	152	67.77	0.02
	standard deviation	10.3	0.00	0.03	0.31	0.54	0.53	133	0.07	0.01	1.36	0.28	0.06	0.23	255	0.22	2.8	49	19.74	0.02
Others																				
	number	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126	1,126
	average	11.9	0.00	0.05	0.19	1.80	0.99	182	0.08	0.06	2.66	0.75	0.19	0.83	414	0.23	17.9	133	74.87	0.03
	standard deviation	6.2	0.00	0.12	0.37	0.86	2.34	88	0.07	0.09	1.14	0.28	0.09	0.43	245	0.19	4.0	57	22.05	0.20

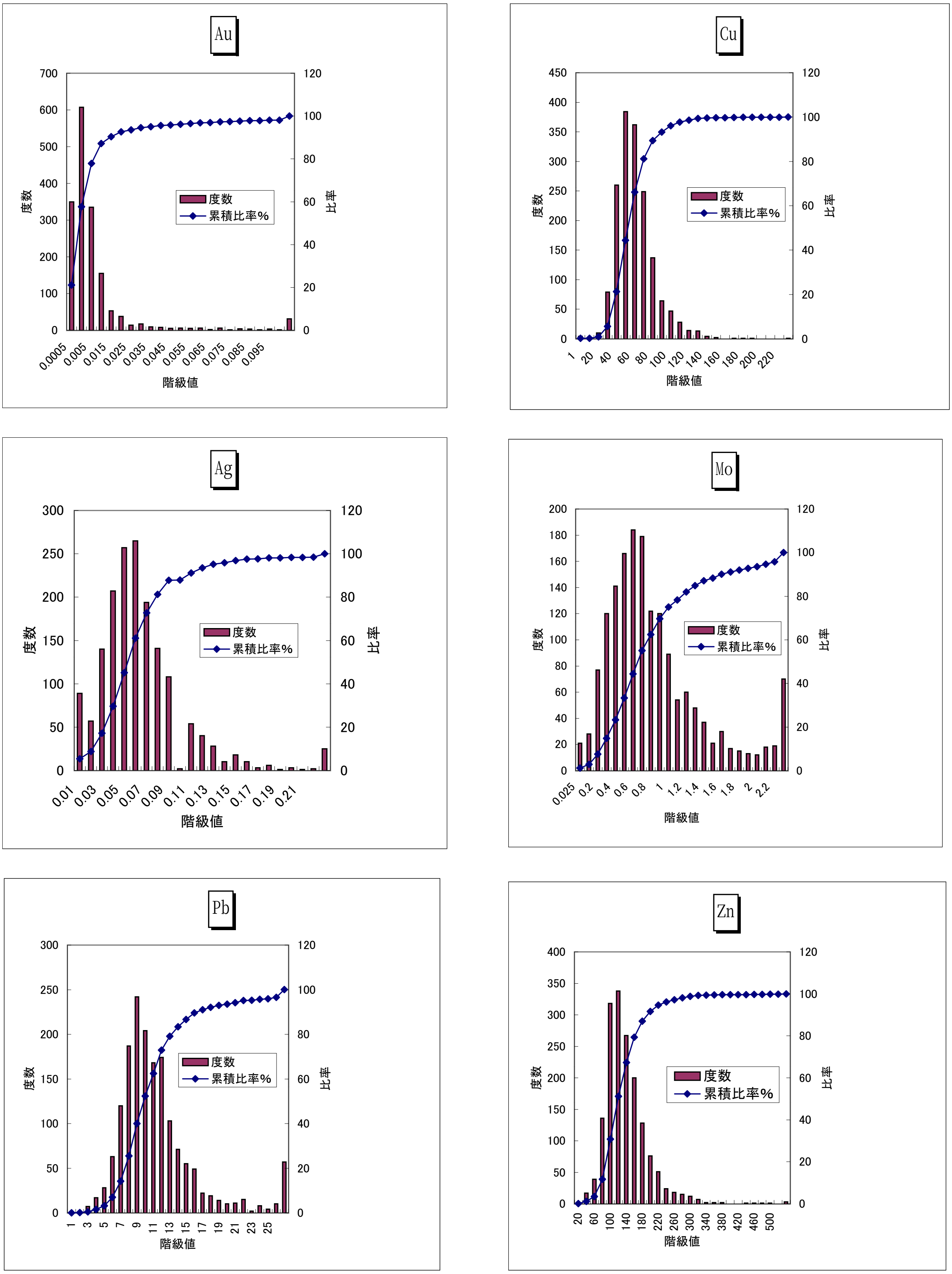
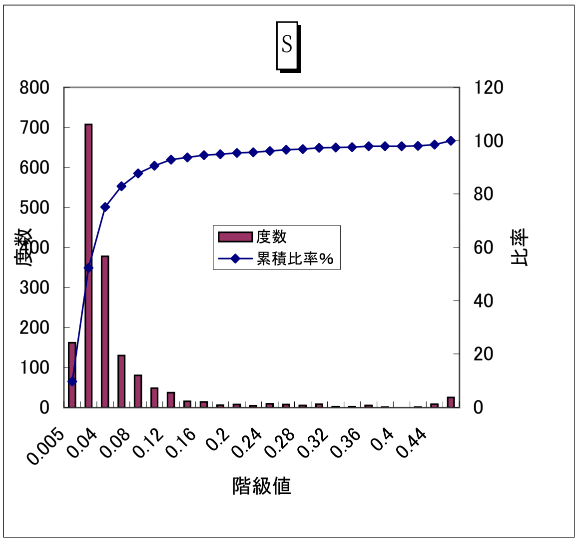
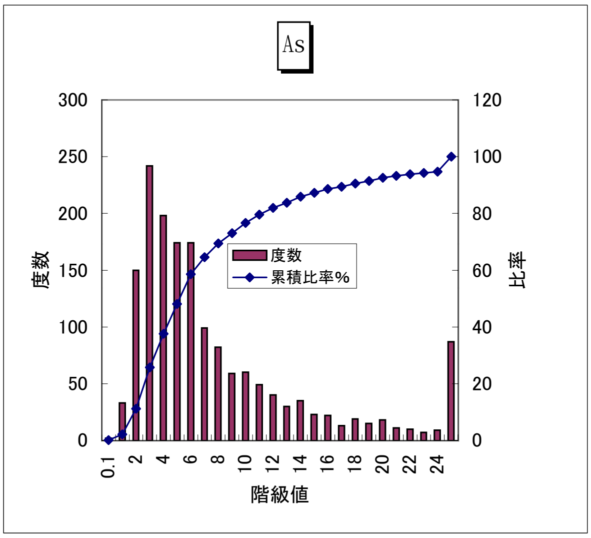
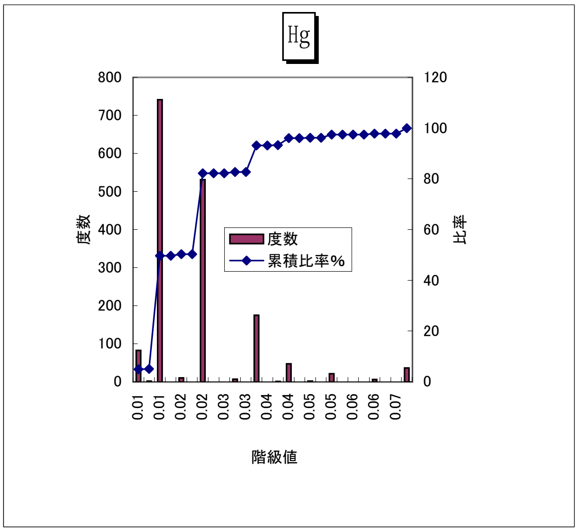


Fig. 3-21 Histogram of Chemical Analysis Data of Stream Sediments (1/2)







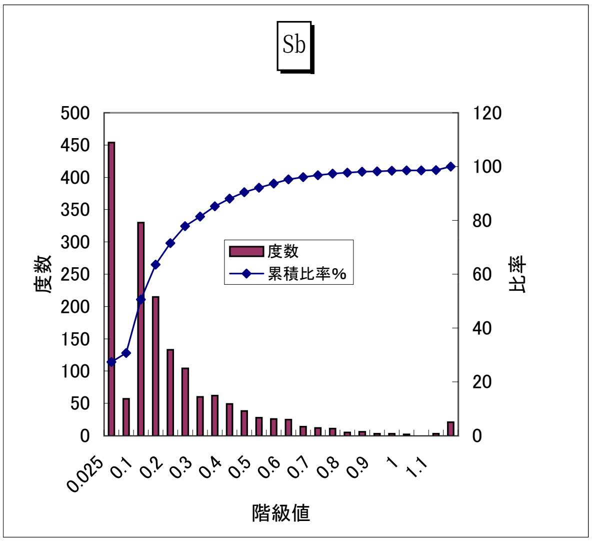


Fig. 3-21 Histogram of Chemical Analysis Data of Stream Sediments (2/2)

Table 3-11 Correlation Coefficients of Stream Sediments Samples

Element	Au	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	In	K	La	Li	Mg	Mn	Mo
Au	1.00	0.74	−0.02	0.17	0.00	−0.02	0.16	−0.03	0.24	−0.01	−0.01	0.02	0.04	0.18	0.00	0.01	−0.01	−0.07	0.09	0.09	−0.01	0.00	0.00	0.03	0.01
Ag		1.00	−0.03	0.17	0.00	−0.01	0.18	−0.06	0.25	0.00	0.02	0.02	0.07	0.15	0.02	0.05	0.01	−0.10	0.15	0.11	0.01	−0.01	−0.03	0.05	0.02
Al			1.00	0.02	0.25	0.61	0.04	−0.50	−0.02	0.20	0.02	−0.06	0.24	0.55	−0.01	0.41	0.08	0.60	0.12	0.02	0.27	0.28	0.02	0.01	−0.02
As				1.00	0.01	0.07	0.22	0.00	0.08	0.07	−0.13	−0.08	0.32	0.00	−0.14	−0.11	−0.11	0.08	−0.01	0.07	0.07	0.29	−0.19	−0.03	0.43
Ba					1.00	0.42	0.03	0.04	0.02	0.70	0.35	−0.08	0.11	0.34	0.08	0.14	0.04	0.24	0.03	−0.16	0.67	0.10	−0.19	0.64	0.05
Be						1.00	0.19	−0.30	0.03	0.64	0.02	−0.16	0.31	0.24	−0.15	0.27	0.13	0.68	0.08	−0.07	0.70	0.52	−0.37	0.22	0.09
Bi							1.00	−0.13	0.39	0.20	−0.13	−0.11	0.10	0.14	−0.16	−0.07	−0.12	−0.05	0.41	0.07	0.19	0.10	−0.24	0.03	0.22
Ca								1.00	−0.08	0.09	−0.19	−0.18	−0.25	−0.28	−0.29	−0.57	−0.37	−0.30	−0.42	−0.30	0.08	0.06	−0.23	0.02	0.16
Cd									1.00	0.09	−0.10	−0.07	−0.02	0.13	−0.12	−0.10	−0.13	−0.14	0.31	0.14	0.08	−0.11	−0.04	0.11	0.06
Ce										1.00	0.30	−0.07	0.08	0.16	−0.04	0.09	0.05	0.36	0.04	−0.30	0.95	0.32	−0.40	0.72	0.13
Co											1.00	0.46	−0.13	0.37	0.88	0.76	0.55	−0.07	0.43	−0.40	0.27	−0.19	0.19	0.63	−0.12
Cr												1.00	−0.14	0.10	0.50	0.36	0.35	−0.11	0.21	−0.11	−0.09	−0.14	0.32	0.17	0.05
Cs													1.00	0.08	−0.13	0.05	0.06	0.24	−0.06	0.38	0.14	0.32	−0.10	−0.08	0.07
Cu														1.00	0.31	0.47	0.16	0.18	0.38	−0.06	0.19	−0.02	0.09	0.18	0.03
Fe															1.00	0.80	0.61	−0.16	0.51	−0.29	−0.04	−0.31	0.29	0.36	−0.14
Ga																1.00	0.63	0.23	0.57	−0.24	0.13	−0.05	0.17	0.26	−0.14
Ge																	1.00	0.10	0.37	−0.11	0.06	−0.03	0.18	0.20	−0.12
Hf																		1.00	−0.03	−0.06	0.41	0.49	−0.24	0.02	0.13
In																			1.00	−0.10	0.05	−0.18	0.06	0.18	−0.02
K																				1.00	−0.30	−0.12	0.37	−0.30	−0.05
La																					1.00	0.39	−0.44	0.63	0.16
Li																						1.00	−0.31	−0.07	0.29
Mg																							1.00	−0.07	−0.21
Mn																								1.00	−0.03
Mo																									1.00
Na																									
Nb																									
Ni																									
P																									
Pb																									
Rb																									
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Ti																									
Tl																									
U																									
V																									
W																									
Y																									
Zn																									
Zr																									
Hg																									

Element	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr	Hg
Au	0.02	0.04	0.04	0.03	0.23	0.11	−0.01	0.10	0.08	0.01	0.01	−0.03	0.04	0.25	−0.01	0.00	0.09	−0.04	0.00	0.05	−0.05	0.30	−0.07	0.64
Ag	0.02	0.06	0.04	0.03	0.20	0.14	−0.01	0.10	0.11	0.08	0.07	−0.06	0.06	0.26	−0.02	0.00	0.10	−0.05	0.02	0.09	−0.03	0.31	−0.09	0.58
Al	0.02	0.09	0.09	0.21	0.00	0.05	−0.03	−0.10	−0.04	−0.07	0.00	−0.17	0.11	0.01	0.42	0.01	0.13	0.13	−0.07	0.04	0.44	−0.06	0.60	0.00
As	−0.14	0.18	−0.10	−0.05	0.05	0.12	0.13	0.43	0.77	0.11	0.03	−0.08	0.18	0.30	0.04	−0.10	0.32	0.26	−0.14	0.34	0.08	−0.08	0.05	0.14
Ba	−0.11	0.24	−0.04	0.23	0.18	−0.08	0.04	−0.05	0.05	−0.06	0.04	0.14	0.17	−0.05	0.62	0.05	0.53	0.30	0.03	0.17	0.32	−0.01	0.29	0.02
Be	−0.20	0.38	−0.08	0.16	0.09	0.08	0.05	−0.05	0.08	0.08	0.09	−0.19	0.34	0.01	0.76	−0.08	0.47	0.43	−0.24	0.28	0.72	−0.23	0.70	0.00
Bi	−0.08	0.13	−0.15	0.09	0.12	0.08	0.20	0.26	0.15	0.28	0.09	−0.20	0.15	0.63	0.13	−0.16	0.27	0.08	−0.19	0.19	0.20	0.05	−0.05	0.19
Ca	−0.19	0.12	−0.27	−0.10	0.00	−0.32	−0.02	0.02	0.13	−0.07	0.00	0.43	0.15	−0.10	0.00	−0.30	−0.02	0.29	−0.24	0.24	−0.27	−0.32	−0.27	−0.02
Cd	0.16	0.05	−0.09	0.12	0.11	0.08	0.03	0.11	0.08	0.03	0.03	−0.14	0.07	0.38	−0.05	−0.14	0.13	−0.08	−0.13	0.09	0.17	0.43	−0.16	0.17
Ce	−0.30	0.43	−0.09	0.14	0.13	−0.18	0.07	−0.05	0.12	0.07	0.10	−0.02	0.35	0.02	0.80	0.00	0.66	0.50	−0.11	0.32	0.61	−0.16	0.42	0.02
Co	−0.23	−0.04	0.61	−0.07	0.03	−0.33	0.14	−0.13	−0.18	0.01	−0.01	−0.12	−0.14	−0.15	0.29	0.68	0.15	0.08	0.85	−0.18	−0.07	0.56	0.00	−0.03
Cr	−0.10	−0.13	0.77	−0.15	−0.01	−0.13	0.04	−0.03	−0.11	0.03	−0.02	−0.19	−0.17	−0.11	−0.06	0.45	−0.07	0.02	0.50	−0.22	−0.15	0.38	−0.09	0.00
Cs	0.03	0.16	−0.09	0.26	0.09	0.60	0.06	0.17	0.25	0.09	0.01	−0.01	0.15	0.15	0.22	−0.11	0.42	0.06	−0.16	0.26	0.16	−0.11	0.24	0.06
Cu	−0.01	−0.05	0.31	0.24	0.06	−0.06	0.08	−0.02	−0.05	−0.09	0.03	−0.06	−0.04	0.15	0.31	0.15	0.12	0.08	0.29	−0.03	0.13	0.28	0.19	0.29
Fe	−0.13	−0.18	0.62	−0.11	0.00	−0.27	0.10	−0.11	−0.23	0.03	−0.05	−0.17	−0.27	−0.18	0.06	0.79	−0.09	−0.03	0.95	−0.32	−0.25	0.70	−0.11	−0.01
Ga	−0.15	−0.05	0.60	−0.01	0.00	−0.15	0.09	−0.15	−0.21	0.08	−0.04	−0.32	−0.12	−0.11	0.29	0.65	0.02	0.04	0.75	−0.22	0.11	0.55	0.28	0.00
Ge	−0.13	0.02	0.40	0.01	0.01	−0.04	0.13	−0.05	−0.13	0.29	0.00	−0.14	−0.06	−0.11	0.13	0.63	0.01	0.00	0.60	−0.12	0.01	0.36	0.19	−0.01
Hf	−0.21	0.33	−0.07	0.08	0.01	0.01	−0.02	−0.02	0.04	0.04	0.03	−0.14	0.29	−0.16	0.55	0.04	0.25	0.38	−0.18	0.17	0.61	−0.26	0.94	−0.06
In	0.00	−0.08	0.26	0.03	0.05	−0.15	0.02	−0.01	−0.12	0.16	−0.02	−0.31	−0.12	0.22	0.05	0.40	0.02	0.01	0.46	−0.18	0.18	0.57	−0.02	0.10
K	0.65	−0.14	−0.17	0.36	0.04	0.87	−0.01	0.13	0.02	−0.07	0.00	0.15	−0.10	0.17	−0.33	−0.21	−0.01	−0.38	−0.27	−0.06	0.01	0.02	−0.12	0.08
La	−0.31	0.50	−0.09	0.18	0.14	−0.16	0.08	−0.05	0.13	0.07	0.10	−0.01	0.42	0.02	0.87	−0.02	0.65	0.56	−0.11	0.38	0.63	−0.17	0.48	0.03
Li	−0.34	0.30	−0.10	−0.05	0.02	0.03	0.05	0.18	0.25	0.08	0.04	0.03	0.33	0.00	0.44	−0.22	0.33	0.60	−0.34	0.37	0.39	−0.38	0.49	0.02
Mg	0.58	−0.28	0.37	0.16	0.00	0.21	−0.03	−0.06	−0.19	−0.10	−0.03	0.32	−0.25	−0.13	−0.43	0.29	−0.42	−0.47	0.33	−0.28	−0.28	0.36	−0.24	−0.02
Mn	−0.17	0.20	0.14	0.07	0.10	−0.25	0.07	−0.11	−0.01	0.02	0.04	0.00	0.12	−0.02	0.46	0.31	0.51	0.18	0.32	0.10	0.25	0.24	0.09	0.02
Mo	−0.14	0.42	0.04	0.02	0.04	−0.04	0.21	0.33	0.42	0.18	0.07	0.04	0.36	0.23	0.11	−0.04	0.25	0.45	−0.11	0.45	0.11	−0.16	0.11	0.04
Na	1.00	−0.16	−0.11	0.34	0.03	0.48	−0.12	−0.03	−0.12	−0.18	0.00	0.30	−0.14	−0.01	−0.34	−0.10	−0.29	−0.46	−0.11	−0.16	−0.08	0.15	−0.25	0.01
Nb		1.00	−0.17	0.18	0.14	0.01	0.09	0.12	0.33	0.30	0.13	0.07	0.91	0.14	0.44	0.05	0.40	0.34	−0.13	0.79	0.26	−0.19	0.38	0.06
Ni			1.00	−0.14	−0.02	−0.13	0.08	−0.09	−0.17	−0.03	−0.05	−0.21	−0.21	−0.12	0.01	0.47	−0.10	−0.02	0.62	−0.25	−0.18	0.43	−0.05	0.01
P				1.00	0.21	0.39	0.04	0.05	0.07	0.10	0.15	0.23	0.16	0.10	0.18	−0.02	0.15	−0.07	−0.11	0.20	0.15	0.05	0.12	0.06
Pb					1.00	0.07	0.00	0.04	0.21	0.04	0.19	0.05	0.11	0.08	0.14	0.03	0.12	0.04	−0.01	0.13	0.05	0.16	0.03	0.16
Rb						1.00	0.02	0.14	0.08	0.03	0.03	0.11	0.01	0.15	−0.14	−0.18	0.17	−0.31	−0.26	0.07	0.02	−0.04	−0.03	0.10
Re							1.00	0.25	0.09	0.18	0.04	−0.06	0.07	0.28	0.08	0.08	0.13	0.07	0.12	0.14	−0.03	0.04	−0.01	−0.02
S								1.00	0.39	0.25	0.03	0.04	0.15	0.36	−0.06	−0.06	0.14	0.15	−0.11	0.25	−0.02	−0.02	−0.04	0.11
Sb									1.00	0.09	0.21	0.01	0.37	0.26	0.07	−0.18	0.32	0.24	−0.22	0.52	0.08	−0.13	0.05	0.10
Se										1.00	0.05	−0.08	0.23	0.23	0.03	0.22	0.13	0.06	0.04	0.25	0.08	−0.04	0.09	0.03
Sn											1.00	0.00	0.13	0.04	0.07	0.00	0.08	0.02	−0.05	0.13	0.07	0.05	0.04	0.01
Sr												1.00	0.08	−0.17	−0.01	−0.11	−0.13	0.02	−0.14	0.14	−0.23	−0.17	−0.11	−0.03
Ta													1.00	0.19	0.37	−0.11	0.34	0.31	−0.23	0.86	0.25	−0.23	0.32	0.06
Te														1.00	−0.07	−0.20	0.20	−0.05	−0.17	0.28	0.05	0.07	−0.17	0.24
Th															1.00	0.06	0.53	0.61	−0.03	0.32	0.51	−0.15	0.62	0.03
Ti																1.00	−0.05	−0.03	0.84	−0.23	−0.12	0.56	0.11	−0.02
Tl																	1.00	0.40	−0.13	0.39	0.41	−0.14	0.28	0.09
U																		1.00	−0.09	0.31	0.35	−0.22	0.41	−0.02
V																			1.00	−0.30	−0.32	0.68	−0.13	−0.02
W																				1.00	0.20	−0.26	0.21	0.08
Y																					1.00	−0.19	0.62	−0.02
Zn																						1.00	−0.24	0.23
Zr																							1.00	−0.05
Hg																								1.00

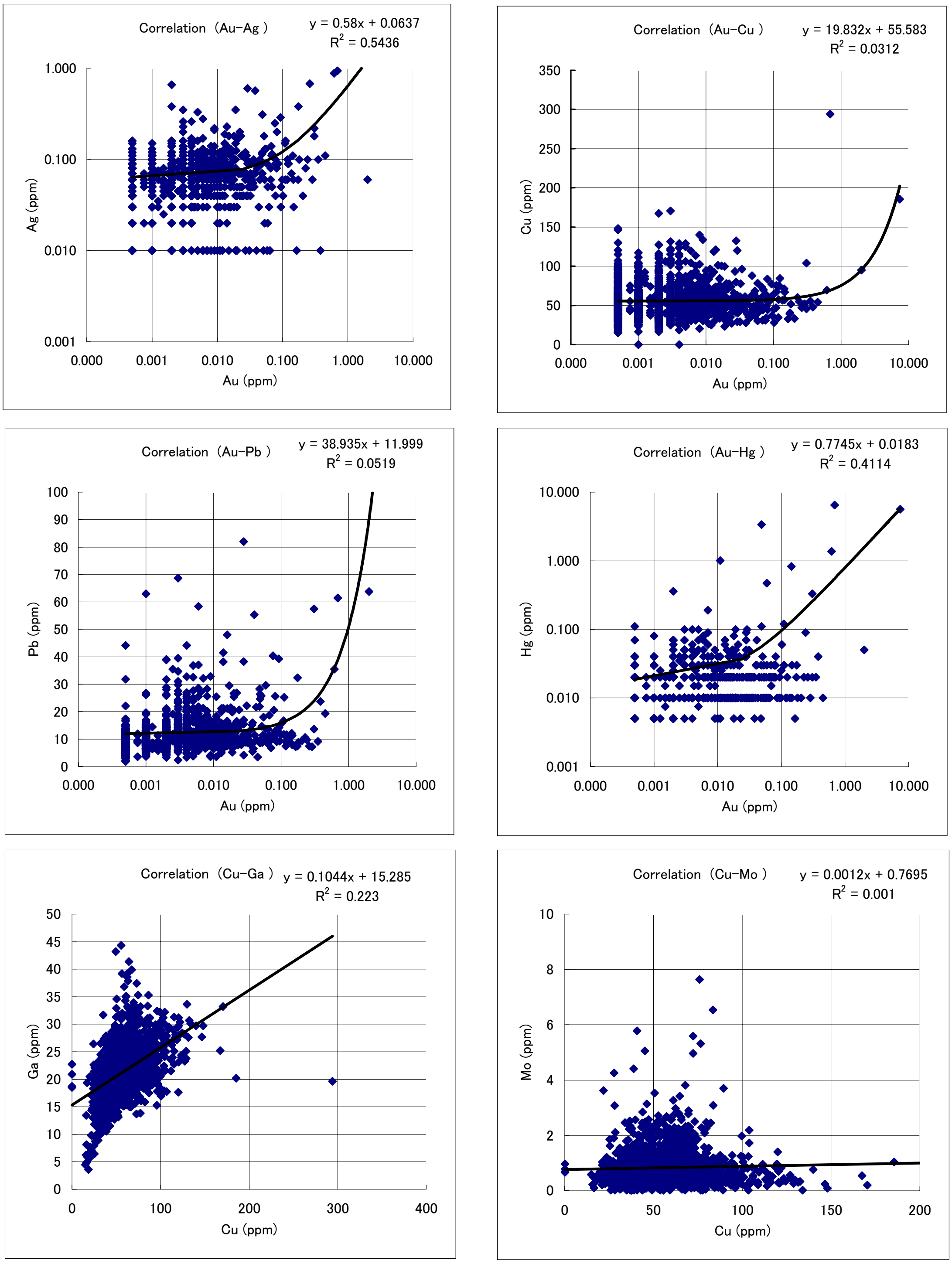


Fig. 3-22 Correlations between Elements in Stream Sediments (1/2)

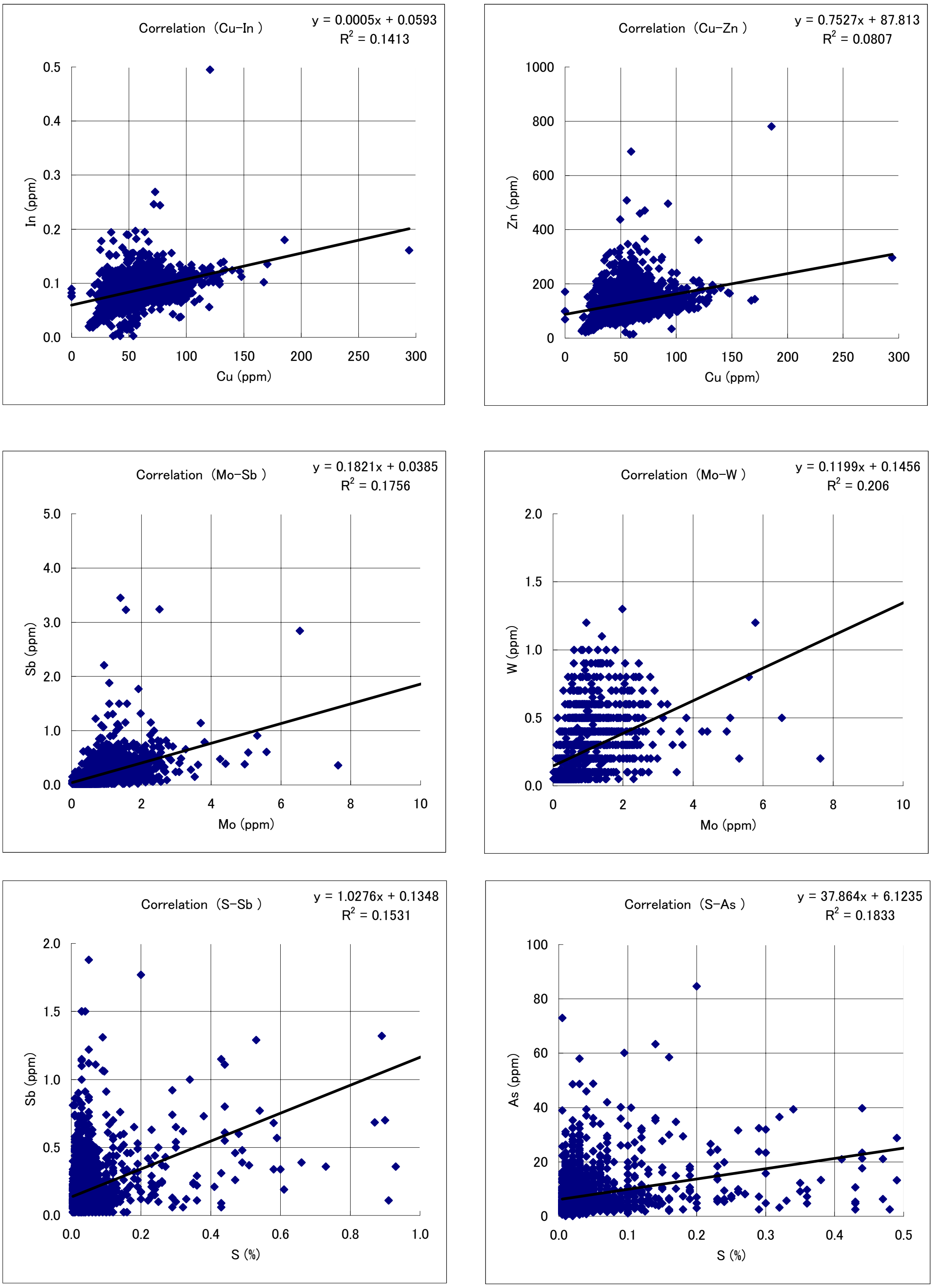


Fig. 3-22 Correlations between Elements in Stream Sediments (2/2)

(8) Results of Panning

Panning was conducted at the 200 sites in the regional geochemical areas in addition to stream sediments sampling. Gold pins (gains) and other heavy minerals in the pan concentrates were identified under microscopy. The non-magnetic portion of the pan concentrates are analyzed, if the portion has enough amount to be analyzed. The following table shows the samples that contain heavy minerals identified by microscopic observation. Gold pins are found in the samples from Selogiri(G040P), Prambon(L171P, L096P, L116P), Purwodadi(G214P), near Wonosari(H050P), southeast of Blitar (L171P) and near Tempursari (I259P, I268P). Chalcopyrite is found in the samples from Seweden(H203P, H204P, H205P), between Purwodadi and Tempursari (G214P, G215P, H222P, H233P, H242P, H246P).

Comparison of chemical between analysis results of the 52 pan concentrates and stream sediments show:

-Average of Ag, Bi, Cd, Cu, Pb, Sn, W, Zn, As, S, Sb, Se and Te values are higher in pan concentrates. That is the consequence of small number of extremely high values in the pan concentrates. The followings are examples of the high values in the pan concentrates:

Ag: 0.53-0.63ppm
As: 136-288ppm
Bi: 6.37ppm
Cd: 33.5ppm
Cu: 878ppm
Pb: 2, 360ppm
S: 10%
Sb: 21.3ppm
Se: 79ppm
Sn: 470ppm
Te: 9.99ppm
W: 2.8ppm
Zn: 310-1,190ppm.

-Sn (tin) is the only one element that shows the ratio of number of samples that chemical analytical values in pan concentrates are higher than in stream sediments is more than 50%. Other elements show that the ratio of number of samples that chemical analytical values in pan concentrates are lower than in stream sediments is more than 50%. For example, Cu is 22%, Pb is 33%, and Zn is 37%. (It is difficult to determine the Au behavior statistically because the number of the pairs is only two, although 2 samples show Au in pan concentrates are high than in stream sediments.

- Cu, Pb, Sn and Zn values in pan concentrates shows high values even at the sites where Cu, Pb, Sn and Zn values in stream sediments are not anomalous. Therefore, panning is also a useful tool for extracting mineralization. Panning may be effective especially for extraction of Sn

-Fig 3-10 shows As values in pan concentrates. The high values are located to south of Klaten within the West area, and Sentul East, between Seweden and Ringinrejo districts, and near Purwodadi district within the East area.

-Among 52 samples only two samples bear to be analyzed for gold in addition to 48 elements. Therefore, the portions containing some amount of magnetic materials might be effective to be analyzed rather than the non-magnetic portions strictly extracted from the pan concentrates.

Table 3-12 Heavy Minerals in Pan Concentrates

Gold	Acanthite	Argentite	Chalcopyrite	Galena	Wolframite
G040P	I229P	H050P	G214P	G214P	G040P
G214P	I240P	H073P	G215P	G215P	
H050P	G040P	H084P	H203P	H203P	
I259P		H186P	H204P	H204P	
I268P		I229P	H205P	H205P	
L074P		I240P	H222P	H222P	
L171P		I268P	H233P	I036P	
L096P		L189P	H242P	L074P	
L116P			H246P	L081P	
				L089P	
				L116P	

2-3-3 Discussions

Twelve districts are selected as geochemical anomalies, where the geochemical anomalous values concentrate and mineralization are found during geological traversing. The districts are roughly defined as to the next stage survey.

(C-1) Selogiri district: This district is one of the most significant areas where geochemical anomalies are concentrated within the Regional Survey area. Gold geochemical anomalies were detected at 4 sites, of which Ag anomalies at 3 sites, Cu anomalies with Pb, Zn, As, Sb and/or Hg anomalies at 2 sites were overlapping. Gold pins were also detected in pan concentrates. One sample of the quartz vein from south of the Selogiri mine returns 21 g/t Au, the width of quartz vein does not exceed 15 cm. Quartz veins in the district often contain chalcopyrite and sphalerite, while the Cu values of the quartz vein is 1.0%. Some other veins contains chalcopyrite more abundantly.

The common alteration minerals in the district identified by X-ray diffraction analysis are haloysite, kaolinite, smectite. In conclusion, the above geochemical anomalies reflect the Au, Ag and Cu with some Pb and Zn mineralization of the district.

(C-2) Prambon District: There are; Au anomalies at 4 sites, Ag anomalies at Ag sites. Of those, Cu anomalies were detected at one site, where Mo, Sb and Hg are also significantly high. Gold pins are identified in the pan concentrates at three sites. In the areas, quartz veinlets trends N-S direction dominantly. The maximum width of the quartz veins is about 0.15m. The highest gold value of the quartz vein samples is 0.8g/tAu(rock chip). However, anomalous gold values in quartz veins indicate that gold mineralization develops widely while gold values of the samples are lower than ore grade. The strike lengths of the veins are yet to be confirmed. The strikes of the veins show similar trending with dyke rocks. Alteration zones consisting of sericite and mixed layer minerals with pyrite dissemination develops widely, although the continuity of the zones should be investigated. In conclusion, it is presumed that the geochemical anomalies reflect the Au and Ag mineralization. However, base metals mineralization also should be investigated that is inferred from diorite intrusion, concentration of sericite alteration and occurrences of Mo geochemical anomalies.

(C-3) Sentul East district: The district is adjacent to the Aneka Tambang concessions where it drilled for Au in silicified zones. Abundant floats of silicified rocks and quartz veins were found in the district, outcrops of quartz veins or silicified rocks are not extensively found since traversing is limited to neighboring areas of the stream sediments sampling sites. There are: Au anomalies at 2 sites, Ag anomalies at 2 sites, and As, Sb, Hg, Mo and Zn anomalies. The existing geologic map shows that faults trending NW-S, N-S and NE-SW directions develop, abundant intrusive rocks crop out. Intense silicification is inferred to occur in the upstream of the stream sediments sample locations. Therefore, mainly Au and Ag mineralization is expected in the district. The alteration minerals identified are sericite, kaolin minerals, smectite, alunite and jarosite, etc. The gold values of altered and mineralized rocks do not return high Au values, Only one silicified float from the western part of the district shows 0.3g/tAu. However, Au and Cu mineralization is expected since the geochemical anomalies is widespread within the district.

(C-4) Sweden district: There are; Au anomalies at 2 sites and Zn, As, Sb, Mo anomalies. Extensive argillic alteration and silicification occurs in the district. Sericite and kaolin minerals are identified. One sample from a narrow quartz vein outcrop returns 2%Cu. Chalcopyrite grains from the pan concentrates were found at two locations. Therefore, Cu mineralization should be pursued in addition to Au mineralization. In the southern part district mineralization is expected to occur in the deeper part since

-A NE-SW trending fault runs along the alteration zone that is identified in this survey. Therefore, the mineralization of the district is controlled by the structure.

-Dacite (quartz porphyry) intruded in the district.

- Intensity of the alteration decreases toward the north of the district. Therefore, the alteration is presumed to be stronger to the south where limestone covers the Tertiary andesitic lava and volcaniclastic rocks that are the most preferable host rock of mineralization.

- The mining concessions that covered most of the district is terminated when this survey was conducted.

(C-5) Purwodadi district: There are; Au anomalies at 2 sites, Ag, Pb, Zn, As, Sb, Mo, As and Hg anomalies in and near the district. Gold pins were detected in the pan concentrate. A boulder of quartz containing chalcopyrite and pyrite with 0.7% Cu, indicating occurrence of promising quartz vein in the upstream of the creek in the Purwodadi village. In the other creek, quartz veins containing chalcopyrite and/ or sphalerite occur sporadically but widely. The widths of the veins are usually less than 5 cm. Base metal mineralization is most promising in this district because of

- outcropping of granodiorite, and

-boulders similar to skarn indicating deeper mineralization.

NE-SW trending faults develop in the district. Sericite, kaolin minerals and pyrophyllite are identified in the altered rocks.

(C-6) Tempursari district: There are Au anomalies at 2 sites and minor As and Cu anomalies. However, gold pins were found at localities. Pyrite dissemination, silicification and argillic alteration develop in and surrounding intrusive rocks. Sericite, mixed layer minerals, kaolin minerals and smectite were identified by X ray diffraction analysis. Quartz veins cropping out in the district are narrow in widths and low in gold values. However, the geochemical anomalies reflect the Au and Cu mineralization.

(C-7) Wonosari district: Evidence of mineralization was not found in the district partly because limestone crops out widely. However, Au, Ag, Cu, Zn, As, Mo and Hg anomalies were detected in the district. Gold pins were found at a site. The mineralization is expected to be found by detailed geochemical survey in the future. Geophysical survey and drilling will be needed to understand the whole picture of the district. It is difficult to define the boundary of the district because it is suspected that dominant area of mineralization is covered.

(C-8) Ringinrejo district: There are many Au, Ag, Cu, As and Mo anomalies in and near Ringinrejo area. They are divided into the Tertiary volcanic rocks area to the south and the Quaternary rock area to the north. The cause of Au geochemical anomalies in the Quaternary rocks area should be investigated. At this time, only the geochemical anomaly area is defined as the Ringinrejo district because mineralization was not found in the Quaternary volcanic rocks area and because quartz veinlets are found in the pyrite dissemination, argillic alteration zones to the south. The highest value of samples from the quartz veins and silicified veins is 0.7g/tAu. However, the district shows rather flat ground and the rocks are exposed in limited areas. Therefore, the mineralization to the depth should be investigated. Also the Quaternary volcanic rocks area to the north should be investigated to reveal the origin of gold pins in the pan concentrates from the Quaternary catchment basin.

(C-9) K.Jingring district: The district has been known as gold mineralization area where DMRI investigated and Au value of a sample from a quartz vein retuned 0.9g/t. The current survey reveals that limited alteration zone develops in the area and a quartz boulder returns 1.4g/tAu.

(C-10) Binagun district: Au, Zn, As, Sb, Hg and Mo anomalies were detected in the wide area south of and adjacent to Ringinrejo district. A few outcrops of quartz veinlets less than 2 cm in width were found in andesitic rocks. However, alteration zone is limited. The mineralization appears to extend along the faults that are shown on the existing geological map. The mineralization of the district is limitedly described in the data provided by DMRI. However, current field survey could not reveal the mineralization was extensive, nor delineate the next stage target area.

(C-11) Purwoharjo district: The Cu anomalies were detected at many places. However, the field survey did not reveal any mineralization and alteration in the district except the limited area of the southwestern part of the district where quartz vein floats and pyrite dissemination were found in andesitic rocks. The high values are concentrated in the Wuni Formation exposed areas. Therefore, it is also suspected that the anomalies may reflect the background high Cu values of Wuni Formation.

(C-12) Tulungagung East district: There are Cu, Zn, As and Hg anomalies in andesite exposure area west of Tulungagung town. No obvious mineralization and hydrothermal alteration were detected during the field traversing.

The following table summarizes the above-mentioned geochemical anomalies.

Table 3-14 Summary of Regional Geochemical Survey

District	Geochemical anomalies	Mineral showings	Possible ore deposits
C1. Selogiri	S.S.: Au, Ag, Cu, Pb, Zn, As, Sb, Hg Pan concentrates：Cu Rock：21g/tAu(max)	-Chalcopyrite, sphalerite quartz veins -Sericite alteration (near Selogiri deposits)	-Au Ag veins -small possibility of porphyry copper deposits at depth
C2. Prambon	S.S.: Au, Ag, As, Sb, Mo Pan concentrates：Au Rock：0.8g/tAu	-Quartz veins -Pyrite dissemination -Sericite alteration	-Au Ag veins -small possibility of porphyry copper deposits at depth
C3. Sentul East	S.S.: Au, Ag, Zn, As, Sb, Hg, Mo Pan concentrates：As Rock：0.3g/tAu(max)	-Silicified zones -Quartz veins -Pyrite dissemination -Argillic alteration (kaolin etc.)	-Au Ag veins (Epithermal)
C4. Sweden	S.S.: Au, Zn, As, Sb, Mo Pan concentrates：Cu Rock：0.2g/tAu(max) 1.1%Cu(max)	-Wide alteration area -Quartz veinlets -Sericite alteration -Kaolin alteration (in terminated KP area)	-Au Ag veins -porphyry copper deposits at depth
C5. Purwodadi	S.S.: Ag, Pb, Zn, As, Sb, Mo, As, Hg Pan concentrates：Au Rock：1.0g/tAu(max) 0.7%Cu(max)	-Chalcopyrite quartz vein -Intrusion of granitic rocks -Pyrite dissemination (within Conservation forest?)	-Au Ag bearing base metals veins (Skarn type deposits)
C6. Tempursari	S.S.: Au, Cu, As Pan concentrates：Au S.S.: 0.08g/tAu(max) 0.7%Cu(max)	-Wide alteration area -Quartz veinlets -Sericite alteration (in effective KP area)	-Unspecified (porphyry copper deposits at depth?)

* S.S.: Stream sediments.

Table 3-14 Summary of Geochemical Survey (continued)

District	Geochemical anomalies	Mineral showings	Possible ore deposits
C7. Wonosari	S.S.: Au, Ag, Cu, Zn, As, Mo, Hg Pan concentrates：Au Rock：0.04g/tAu(max)	-Unknown (limestone areas)	Unspecified
C8. Seweden East (Ringinrejo and the north)	S.S.: Au, Ag, Cu, As, Mo Pan concentrates：Au Rock：0.7g/tAu(max)	-Quartz veinlets -Pyrite dissemination (within terminated KP)	-Au Ag veins
C9. K.Jingring	S.S.: Au Rock：0.9g/tAu(max)	-Quartz vein/ floats -Limited alteration zone	-Au Ag veins
C10. Binagun	S.S.: Au, Zn, As, Sb, Hg, Mo Rock：0.3g/tAu(max)	-Quartz float -Limited alteration zone	-Au Ag veins
C11. Pruwoharjo	S.S.: Cu, Zn, As, Hg, Mo (Rock to south：0.3g/tAu(max)	-Mineralization undetected	-Unspecified
C11. Tulungagung West	S.S.: Cu, Zn, As, Hg (Rock：low values)	-Mineralization undetected	-Au Ag veins

* S.S.: Stream sediments.

Table 3-13 Summary of Geochemical Anomaly Data (1/2)

Sample No.	Au	Ag	As	Ba	Bi	Cd	Co	Cr	Cu	Ga	Ge	In	Mn	Mo	Ni	Pb	S	Sb	Se	Sn	Te	W	Zn	Hg
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
G041S	7.4000	4.62	89.9	270	0.86	1.92	23.1	72	186	20.2	0.23	0.18	2,470	1.04	30.3	296	0.530	1.290	2.0	1.1	0.990	0.60	781	5.630
K205S	2.0000	0.06	1.8	300	0.09	0.15	68.9	84	95	29.7	0.43	0.11	1,915	0.38	37.1	64	0.020	0.120	1.0	3.7	0.070	0.05	212	0.050
G042S	0.6910	0.94	21.3	280	0.77	0.37	14.0	40	294	19.6	0.22	0.16	991	2.55	16.5	61	0.440	0.800	2.0	1.5	0.540	0.70	297	6.490
G037S	0.6140	0.88	9.3	360	0.28	0.47	35.5	54	69	21.6	0.23	0.08	3,220	0.70	21.6	36	0.090	0.230	1.0	0.9	0.060	0.20	177	1.370
G081S	0.4500	0.11	12.0	158	0.23	0.44	41.1	93	54	20.2	0.28	0.09	1,900	0.73	22.2	19	0.030	0.070	2.0	0.7	0.100	0.10	175	0.010
H057E	0.3810	0.01	7.9	510	0.19	0.19	42.7	25	48	12.8	0.22	0.06	3,340	1.26	0.1	24	0.060	0.380	2.0	1.4	0.120	0.70	163	0.040
I087S	0.3510	0.10	15.7	193	0.10	0.11	44.3	60	55	25.8	0.36	0.11	2,040	0.58	23.6	9	0.020	0.160	2.0	0.7	0.025	0.10	156	0.020
I284S	0.3070	0.18	8.4	210	0.27	0.68	30.0	15	104	17.9	0.28	0.08	2,230	2.19	10.4	14	0.090	0.370	4.0	1.0	0.630	0.40	120	0.020
G040S	0.3060	0.22	9.3	137	0.11	0.52	24.1	46	46	23.3	0.21	0.07	1,510	0.79	27.3	58	0.010	0.280	1.0	0.8	0.070	0.30	247	0.330
G079E	0.2870	0.06	9.1	153	0.05	0.10	52.2	122	52	25.7	0.42	0.11	2,060	0.14	23.4	7	0.010	0.025	2.0	0.3	0.025	0.05	216	0.010
J212S	0.2620	0.68	3.0	250	0.06	0.130	47.4	50	47	24.5	0.24	0.10	1,860	0.50	24.4	7	0.020	0.025	2.0	0.5	0.025	0.05	166	0.020
G149E	0.2410	0.10	31.5	260	0.08	0.090	31.0	22	55	17.5	0.22	0.08	1,540	0.68	6.7	10	0.120	0.390	1.0	0.9	0.100	0.50	117	0.090
K189S	0.2260	0.08	15.4	240	0.18	0.160	29.5	26	60	18.6	0.16	0.08	1,120	2.18	13.6	11	0.100	0.310	2.0	0.9	0.060	0.50	93	0.020
L082E	0.2050	0.04	3.9	180	0.10	0.110	48.6	89	33	23.8	0.50	0.10	2,240	0.61	20.1	10	0.030	0.060	3.0	1.0	0.025	0.10	234	0.010
L233S	0.1800	0.10	4.5	124	0.55	0.580	17.6	26	52	17.3	0.25	0.14	1,345	0.68	8.6	9	0.130	0.100	3.0	1.6	0.260	0.10	158	0.010
L080E	0.1750	0.38	10.5	380	0.25	1.060	42.6	34	41	19.8	0.43	0.08	2,680	0.47	13.8	32	0.010	0.090	2.0	0.8	0.025	0.10	166	0.030
H207S	0.1730	0.06	2.5	230	0.09	0.120	18.9	15	39	12.0	0.10	0.05	1,355	1.65	6.7	7	0.120	0.560	2.0	0.8	0.025	0.50	63	0.020
H093E	0.1640	0.01	5.5	230	0.01	0.100	27.6	44	33	18.7	0.31	0.07	1,315	0.46	8.9	7	0.010	0.090	2.0	1.0	0.025	0.20	92	0.005
G231S	0.1470	0.03	4.7	143	0.17	0.250	37.9	114	67	19.9	0.36	0.10	2,130	1.30	21.8	11	0.430	0.310	2.0	1.4	0.230	0.30	174	0.030
G112E	0.1460	0.06	2.3	240	0.08	0.110	43.2	46	57	23.4	0.20	0.09	1,665	0.32	18.0	8	0.005	0.110	2.0	0.9	0.025	0.30	160	0.010
L148S	0.1440	0.11	7.7	320	0.14	0.140	64.4	72	71	31.4	0.50	0.12	2,290	1.31	33.2	12	0.020	0.080	3.0	1.1	0.025	0.30	195	0.830
L108S	0.1360	0.07	4.6	170	0.06	0.180	34.0	59	57	23.1	0.59	0.06	1,550	0.62	18.5	9	0.020	0.110	2.0	0.8	0.025	0.10	140	0.010
I273S	0.1240	0.09	3.7	166	0.17	0.320	39.4	73	84	21.8	0.31	0.10	1,750	0.40	23.1	10	0.090	0.050	0.5	0.6	0.110	0.10	175	0.020
I206S	0.1210	0.09	2.3	580	0.12	0.160	67.3	61	75	31.3	0.35	0.14	3,070	0.09	28.3	12	0.020	0.025	2.0	0.4	0.025	0.05	219	0.010
L238E	0.1190	0.10	4.5	133	0.50	0.330	20.6	25	57	17.9	0.26	0.11	1,735	0.70	14.0	9	0.090	0.120	3.0	1.4	0.260	0.20	181	0.010
H140S	0.1180	0.06	12.0	200	0.08	0.120	12.4	17	35	12.0	0.13	0.05	691	1.80	10.5	7	0.050	0.470	0.5	0.8	0.025	0.40	87	0.010
K101S	0.1110	0.16	14.5	420	0.18	0.630	27.5	27	67	20.5	0.18	0.08	1,585	0.65	14.4	25	0.060	0.520	3.0	0.9	0.120	0.50	118	0.030
G151S	0.1100	0.06	27.8	330	0.15	0.120	35.7	25	76	21.9	0.23	0.09	1,855	1.23	10.6	12	0.030	0.110	1.0	1.1	0.050	0.30	103	0.030
G043S	0.1090	0.15	5.0	250	0.14	0.140	24.8	18	47	20.6	0.25	0.08	1,525	0.31	14.4	17	0.020	0.110	1.0	0.7	0.025	0.10	101	0.120
J078S	0.1020	0.04	1.5	340	0.10	0.100	30.0	16	28	20.3	0.34	0.08	1,940	0.85	7.8	16	0.040	0.100	2.0	1.5	0.025	0.50	185	0.060
L070S	0.1005	0.04	10.6	250	0.09	0.110	34.3	43	45	23.0	0.43	0.07	1,513	1.14	15.8	12	0.190	0.380	2.0	1.5	0.025	0.45	144	0.025
I142S	0.0990	0.06	12.0	320	0.11	0.150	42.4	27	64	26.5	0.34	0.11	2,120	0.58	15.9	12	0.010	0.025	2.0	1.1	0.025	0.10	132	0.010
G094S	0.0950	0.05	3.1	182	0.06	0.075	35.1	68.5	37	20.0	0.40	0.06	1,238	0.19	14.9	9	0.020	0.025	1.5	0.8	0.025	0.08	126	0.010
L034S	0.0940	0.03	5.1	240	0.17	0.190	40.9	54	77	24.7	0.46	0.10	1,905	0.83	22.8	14	0.030	0.110	2.0	1.5	0.060	0.50	103	0.020
K098E	0.0930	0.29	36.1	211	0.18	0.320	19.3	19	61	17.1	0.20	0.07	1,230	0.77	11.4	39	0.140	0.590	2.0	0.9	0.110	0.60	124	0.010
J124E	0.0860	0.09	2.5	190	0.05	0.150	32.2	47	55	18.2	0.36	0.08	1,735	0.55	12.2	9	0.010	0.110	2.0	1.0	0.080	0.20	161	0.010
L093E	0.0820	0.20	17.7	201	0.14	0.220	25.3	37	44	18.0	0.41	0.06	1,185	1.31	13.3	26	0.440	1.110	2.0	1.0	0.080	0.70	111	0.040
L191S	0.0810	0.09	4.3	430	0.15	0.210	60.4	44	84	30.7	0.41	0.12	2,600	0.50	25.3	13	0.030	0.050	2.0	0.5	0.025	0.30	174	0.020
H211S	0.0810	0.08	9.9	230	0.10	0.160	36.4	48	55	22.6	0.33	0.09	2,290	0.80	16.4	10	0.030	0.070	0.5	0.8	0.080	0.05	144	0.030
K182S	0.0780	0.09	17.6	201	0.39	0.170	34.6	42	49	16.6	0.16	0.10	1,350	1.89	13.8	21	0.070	0.270	3.0	1.6	0.130	0.20	120	0.020
I090S	0.0780	0.10	22.4	230	0.13	0.140	35.4	46	64	23.5	0.37	0.09	2,020	1.30	19.0	11	0.030	0.740	2.0	1.1	0.090	0.60	114	0.030
L090E	0.0780	0.04	6.9	200	0.11	0.120	40.5	81	34	20.8	0.45	0.08	1,860	0.78	18.4	10	0.100	0.025	3.0	0.7	0.025	0.10	182	0.030
H218S	0.0760	0.25	18.0	189	0.06	0.550	13.6	23	31	18.1	0.16	0.09	1,045	1.54	9.8	40	0.150	0.520	1.0	1.3	0.080	0.30	142	0.020
J103E	0.0710	0.11	1.4	186	0.04	0.110	45.8	61	70	22.1	0.48	0.09	1,660	0.70	22.5	7	0.020	0.130	2.0	0.9	0.025	0.20	167	0.020
K088S	0.0695	0.12	40.0	160	0.23	0.120	21.3	19.5	44	18.8	0.35	0.06	1,129	1.02	10.6	11	0.105	0.610	2.0	1.0	0.118	0.60	88	0.015
J065S	0.0690	0.05	3.9	310	0.15	0.140	27.6	27	31	19.5	0.33	0.08	2,040	1.08	8.0	1185	0.050	1.880	2.0	2.0	0.025	0.70	174	0.030
I272S	0.0680	0.11	3.4	211	0.29	0.220	39.2	49	61	23.8	0.34	0.11	1,895	0.26	20.5	11	0.040	0.080	0.5	0.4	0.090	0.20	211	0.020
L187S	0.0670	0.14	4.6	390	0.07	0.230	46.2	43	73	24.8	0.43	0.10	2,880	0.66	20.6	19	0.030	0.025	2.0	2.2	0.025	0.10	158	0.020
H150E	0.0660	0.06	7.0	240	0.04	0.120	66.2	67	50	25.8	0.59	0.11	2,420	0.44	28.9	10	0.010	0.110	1.0	0.4	0.025	0.30	201	0.010
I100E	0.0660	0.08	4.6	195	0.05	0.150	64.2	92	57	24.8	0.41	0.11	2,790	0.44	31.7	9	0.020	0.050	1.0	0.4	0.025	0.10	220	0.020
H095S	0.0640	0.01	7.8	700	0.07	0.140	37.5	25	56	23.4	0.30	0.09	2,160	0.84	10.7	14	0.030	0.200	2.0	1.1	0.100	0.60	94	0.020
J040S	0.0620	0.03	1.7	165	0.09	0.050	43.6	110	56	26.6	0.42	0.10	2,000	0.55	23.3	9	0.010	0.060	2.0	0.7	0.025	0.10	170	0.010
H052E	0.0590	0.02	13.2	740	0.28	0.280	67.1	46	52	22.6	0.34	0.10	5,050	0.78	11.2	30	0.020	0.350	2.0	1.4	0.090	0.20	102	0.030
J064S	0.0590	0.05	1.6	250	0.11	0.130	53.1	46	41	26.3	0.52	0.12	2,700	1.00	17.0	14	0.080	0.025	3.0	0.8	0.025	0.10	316	0.470
H089E	0.0580	0.01	4.2	211	0.07	0.110	32.6	51	30	18.8	0.29	0.07	1,230	0.48	11.0	10	0.060	0.090	2.0	1.0	0.100	0.20	120	0.010
I262S	0.0580	0.09	6.4	180	0.31	0.230	30.4	31	78	21.4	0.27	0.11	1,550	0.77	13.8	11	0.080	0.025	2.0	1.1	0.160	0.10	142	0.010
H090S	0.0580	1.90	10.8	370	0.01	0.190	28.8	32	44	22.0	0.28	0.08	2,760	0.67	13.2	11	0.030	0.150	1.0	1.3	0.060	0.50	104	0.020
G216E	0.0550	0.13	2.0	96	0.16	1.540	13.0	27	44	14.2	0.16	0.10	877	0.73	9.5	18	0.010	0.025	1.0	1.3	0.080	0.20	242	0.010
L146E	0.0540	0.13	6.8	270	0.13	0.110	80.6	112	61	35.1	0.68	0.14	2,500	1.42	37.0	11	0.060	0.170	4.0	1.0	0.025	0.40	259	0.020
J239S	0.0520	0.18	3.7	172	0.07	0.120	111.0	222	64	41.4	0.70	0.15	2,830	0.40	65.8	15	0.020	0.120	0.5	0.5	0.180	0.30	336	0.010
L072S	0.0490	0.12	7.4	160	0.23	0.250	54.2	148	42	26.3	0.51	0.11	2,420	1.15	27.6	25	0.250	0.100	3.0	1.4	0.110	0.20	272	0.020
H013S	0.0490	0.31	9.6	350	0.23	0.260	51.6	43	64	20.6	0.48	0.08	3,410	0.53	9.9	26	0.050	0.560	4.0	1.5	0.080	0.40	102	3.380
I078S	0.0485	0.12	60.1	158	0.24	0.190	22.6	31	42	19.5	0.38	0.06	1,153	1.37	14.8	10	0.095	1.060	3.5	0.9	0.130	0.65	101	0.030
H097E	0.0430	0.03	4.5	430	0.04	0.150	66.9	222	35	31.7	0.68	0.12	2,470	0.96	26.8	22	0.040	0.025	2.0	0.6	0.025	0.10	287	0.010
H096E	0.0380	0.57	5.2	260	0.01	0.280	28.9	150	56	17.6	0.28	0.06	1,270	0.28	33.0	16	0.120	0.220	2.0	0.9	0.060	0.40	132	0.005
K119S	0.0320	0.07	3.4	250	0.07	0.120	86.3	91	50	34.6	0.34	0.15	2,730	0.32	34.4	9	0.005	0.025	2.0	0.5	0.025	0.05	276	0.010
H064E	0.0290	0.60	9.4	460	0.30	0.270	54.1	53	120	17.7	0.26	0.06	3,370	1.40	7.2	292	0.110	3.450	2.0	71.4	0.090	0.90	362	0.100
I076S	0.0280	0.11	84.6	148	0.16	0.360	26.8	32	48	18.7	0.21	0.06	1,340	1.92	19.2	11	0.200	1.770	3.0	0.9	0.410	0.60	99	0.010
H250S	0.0280	0.10	21.0	250	0.47	0.990	37.2	89	80	18.5	0.28	0.15	1,825	1.40	20.6	38	0.410	0.210	2.0	2.1	0.120	0.10	289	0.020
K081S	0.0280	1.40	0.1	15	0.05	0.080	126.5	192	56	44.3	0.66	0.20	3,770	0.03	59.2	4	0.010	0.025	3.0	0.4	0.025	0.05	508	0.070
H061E	0.0280	0.04	2.5	2,080	0.20	0.350	65.2	42	59	15.1	0.21	0.06	4,410	1.54	0.9	82	0.430	1.150	1.0	4.3	0.080	0.90	232	0.090
G001S	0.0220	0.20	20.3	240	0.13	0.550	20.2	43	37	20.3	0.22	0.06	2,450	0.88	20.2	27	0.010	0.860	1.0	1.0	0.200	0.90	304	0.030
L203S	0.0190	0.10	1.1	310	0.09	0.120	101.0	116	73	37.4	0.67	0.14	3,140	0.17	43.9	8	0.020	0.025	1.0	0.1	0.025	0.30	319	0.010
K094S	0.0190	0.35	59.7	169	0.48	0.450	45.3	16	100	18.4	0.24	0.07	2,320	1.98	16.8	20	0.890	1.320	7.0	1.1	0.550	1.30	136	0.050
I109E	0.0170	0.12	58.0	350	0.26	0.380	26.6	51	35	17.7	0.33	0.07	1,350	0.85	14.7	15	0.030	1.100	2.0	0.9	0.025	0.10	134	0.050

Table 3-13 Summary of Geochemical Anomaly Data (2/2)

Sample No.	Au	Ag	As	Ba	Bi	Cd	Co	Cr	Cu	Ga	Ge	In	Mn	Mo	Ni	Pb	S	Sb	Se	Sn	Te	W	Zn	Hg
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
H162E	0.0160	0.06	22.9	230	0.17	0.180	63.0	569	76	23.4	0.69	0.14	2,080	7.64	62.0	17	0.010	0.360	3.0	0.7	0.025	0.20	197	0.020
I075S	0.0150	0.18	39.4	186	0.23	0.190	22.8	23	36	19.3	0.19	0.07	1,090	2.36	14.8	16	0.340	1.000	3.0	1.1	0.390	0.80	90	0.040
J299E	0.0140	0.23	9.0	218	0.65	2.860	17.4	46	72	19.2	0.20	0.25	1,645	1.24	7.0	38	0.120	0.350	3.0	1.7	0.360	0.30	471	0.020
G147E	0.0130	0.06	73.0	171	0.08	0.110	24.1	34	39	13.8	0.20	0.06	1,360	1.51	9.2	7	0.005	0.810	1.0	0.8	0.025	0.40	115	0.010
J118S	0.0130	0.10	6.4	167	0.25	1.990	34.3	38	72	17.8	0.32	0.11	2,130	0.65	13.0	16	0.130	0.230	3.0	1.2	0.320	0.20	366	0.010
J266E	0.0130	0.19	4.2	2,010	0.09	0.220	63.0	75	93	25.3	0.34	0.10	1,845	0.73	39.4	417	0.100	0.740	1.0	1.5	0.070	0.20	496	0.010
K097S	0.0130	0.13	39.9	195	0.47	0.160	28.6	29	64	17.6	0.23	0.08	1,165	1.64	16.6	13	1.180	0.700	6.0	1.1	0.430	0.90	101	0.020
G222S	0.0130	0.15	36.1	191	0.07	0.180	20.1	15	46	17.6	0.22	0.07	1,130	0.89	9.4	5	0.050	0.730	3.0	1.0	0.100	0.60	95	0.030
G080E	0.0110	0.08	1.7	105	0.05	0.090	65.9	212	53	28.4	0.49	0.12	2,390	0.09	33.6	7	0.010	0.025	2.0	0.3	0.025	0.05	281	0.005
J079S	0.0110	0.05	3.0	400	0.13	0.170	25.0	11	41	19.9	0.37	0.07	1,585	1.02	6.2	18	0.050	0.150	2.0	1.7	0.025	0.80	146	1.010
G030S	0.0100	0.04	0.9	185	0.07	0.120	71.1	111	45	27.5	0.39	0.10	2,950	0.06	30.9	14	0.005	0.025	1.0	0.6	0.025	0.10	318	0.005
I081S	0.0090	0.12	27.0	202	0.10	0.270	16.7	17	30	18.9	0.25	0.07	701	1.32	7.9	16	0.070	1.110	2.0	1.4	0.090	0.50	106	0.020
G223S	0.0090	0.10	48.8	180	0.05	0.160	24.0	56	36	16.5	0.20	0.07	2,030	0.69	17.4	4	0.050	1.220	2.0	1.0	0.160	0.70	105	0.030
I207S	0.0080	0.12	35.2	151	0.77	0.500	23.7	40	49	20.1	0.30	0.12	1,155	1.58	13.7	20	0.140	0.490	3.0	1.6	0.490	0.40	144	0.010
G165E	0.0080	0.06	7.3	340	0.08	0.140	64.1	90	53	26.6	0.29	0.10	2,460	0.41	34.3	8	0.005	0.025	0.5	0.3	0.025	0.10	269	0.020
K076S	0.0070	0.06	26.1	187	0.11	0.150	27.6	136	46	18.8	0.45	0.08	1,645	1.18	22.1	12	0.090	1.310	2.0	1.0	0.050	0.40	96	0.090
H135E	0.0060	0.06	39.0	280	0.08	0.100	34.5	41	52	20.4	0.21	0.07	1,740	0.47	16.0	8	0.005	0.210	0.5	0.6	0.025	0.10	163	0.010
L204S	0.0060	0.11	0.4	320	0.10	0.180	95.8	112	86	35.3	0.67	0.13	3,110	0.13	39.2	8	0.020	0.025	3.0	0.1	0.025	0.50	289	0.020
L094E	0.0060	0.05	8.9	180	0.19	0.160	25.1	60	39	17.6	0.40	0.06	1,025	4.41	19.1	13	1.940	0.390	3.0	1.1	0.080	0.40	104	0.030
I070S	0.0060	0.05	32.4	195	0.41	0.300	27.1	27	38	19.7	0.39	0.08	1,320	2.25	12.6	18	0.290	0.920	4.0	1.2	0.270	0.70	108	0.040
H054E	0.0060	0.01	13.6	510	0.29	0.320	57.8	35	67	24.1	0.32	0.10	4,400	1.28	10.0	58	0.030	1.000	2.0	3.0	0.140	1.00	148	0.050
L084E	0.0050	1.54	13.7	201	0.07	0.090	23.6	22	29	17.0	0.49	0.05	1,310	0.56	8.8	9	0.030	0.130	2.0	1.0	0.025	0.10	88	0.010
G215S	0.0050	0.07	4.3	105	0.53	1.520	22.1	30	87	17.5	0.18	0.16	2,680	0.77	17.0	7	0.080	0.130	1.0	1.5	0.360	0.40	299	0.010
J300E	0.0050	0.12	7.4	153	0.45	1.525	11.8	8.5	64	18.5	0.16	0.20	1,628	0.76	3.7	25	0.055	0.260	2.0	1.6	0.145	0.30	341	0.015
I213S	0.0050	0.12	40.2	123	0.20	0.190	22.9	23	34	18.7	0.30	0.10	1,210	0.69	7.7	7	0.090	0.250	2.0	0.9	0.250	0.10	118	0.020
I107E	0.0050	0.09	48.6	410	0.10	0.110	28.9	28	47	19.6	0.33	0.08	1,835	0.93	11.1	10	0.020	2.210	2.0	0.8	0.025	0.20	111	0.070
K077S	0.0050	0.09	30.3	218	0.11	0.180	43.6	255	58	18.8	0.42	0.08	2,460	1.36	46.2	10	0.030	1.500	2.0	0.8	0.060	0.40	82	0.100
I212S	0.0040	0.10	36.5	149	0.56	0.270	24.2	19	45	17.2	0.31	0.10	1,655	1.32	8.3	10	0.320	0.620	5.0	1.2	0.620	0.60	114	0.010
I236S	0.0040	0.10	58.5	230	0.27	0.160	26.2	32	60	19.0	0.32	0.09	1,175	1.26	14.2	10	0.160	0.320	0.5	0.9	0.210	0.10	98	0.020
I136S	0.0040	0.05	35.3	310	0.17	0.170	37.2	49	70	22.3	0.27	0.10	2,140	2.29	17.2	15	0.020	0.590	2.0	1.3	0.090	0.60	82	0.030
K075E	0.0040	0.05	26.2	200	0.06	0.110	39.6	154	36	18.6	0.44	0.09	2,170	1.08	28.2	10	0.030	1.500	2.0	0.9	0.025	0.40	126	0.060
G156E	0.0030	0.04	4.6	182	0.06	0.110	65.4	86	40	23.1	0.31	0.11	2,430	0.36	28.4	7	0.005	0.025	1.0	0.3	0.025	0.05	270	0.010
G182S	0.0030	0.13	8.0	106	0.49	1.120	16.7	46	52	16.7	0.19	0.16	1,330	0.80	13.6	21	0.100	0.150	0.5	1.2	0.330	0.20	276	0.010
J125S	0.0030	0.12	0.8	166	0.05	0.120	55.2	182	48	27.2	0.53	0.14	2,880	0.48	32.3	10	0.010	0.025	2.0	0.7	0.025	0.10	300	0.010
J298E	0.0030	0.20	9.6	145	0.51	2.190	14.9	10	67	18.9	0.20	0.18	1,605	0.73	5.6	35	0.190	0.320	2.0	1.5	0.270	0.30	460	0.010
G178E	0.0030	0.04	42.0	400	0.09	0.160	40.8	42	47	15.0	0.16	0.06	2,900	2.57	15.2	11	0.070	0.420	1.0	0.8	0.060	0.40	118	0.020
I108S	0.0030	0.08	46.0	260	0.12	0.110	24.0	32	42	19.1	0.33	0.07	1,375	1.59	14.2	11	0.040	1.500	2.0	0.9	0.060	0.50	89	0.030
I105E	0.0030	0.06	33.3	250	0.17	0.110	24.1	39	40	17.0	0.29	0.07	1,300	1.20	14.4	11	0.100	0.910	2.0	1.1	0.190	0.60	103	0.030
G139S	0.0030	0.07	5.3	181	0.11	0.130	70.9	95	59	25.4	0.34	0.12	3,240	0.37	25.7	9	0.050	0.025	0.5	0.6	0.025	0.05	298	0.030
G176E	0.0030	0.04	37.0	200	0.08	0.090	16.8	14	35	10.6	0.11	0.04	1,045	1.56	8.3	6	0.040	3.230	0.5	0.6	0.050	0.50	66	0.050
L266E	0.0030	0.06	5.8	690	0.23	0.170	62.0	160	171	33.2	0.35	0.14	2,550	0.20	54.7	18	0.020	0.025	0.5	0.5	0.025	0.05	144	0.050
I191E	0.0020	0.04	70.0	270	0.04	0.140	21.6	8	32	10.0	0.14	0.05	1,295	1.43	7.2	8	0.580	0.680	2.0	0.7	0.070	0.50	54	0.010
G095S	0.0020	0.04	3.7	230	0.05	0.090	24.3	27	45	21.1	0.24	0.07	1,360	0.53	11.0	9	0.030	0.060	2.0	1.1	0.060	0.10	85	0.010
H196E	0.0020	0.11	21.2	218	0.14	0.280	41.1	320	64	19.9	0.27	0.08	1,600	17.75	121.0	13	0.110	0.440	3.0	2.2	0.070	1.10	122	0.010
G126E	0.0020	0.05	1.9	150	0.06	0.120	73.3	110	45	25.3	0.27	0.10	2,350	0.26	31.7	7	0.005	0.025	1.0	0.4	0.025	0.10	277	0.010
L209E	0.0020	0.08	1.1	305	0.09	0.135	91.6	96	70	33.9	0.50	0.13	2,770	0.23	40.9	9	0.015	0.103	1.0	0.2	0.053	0.18	281	0.010
J234E	0.0020	0.06	25.6	400	0.16	0.190	32.7	34	72	21.5	0.20	0.09	1,685	4.96	18.6	15	0.020	0.380	1.0	1.0	0.070	0.40	72	0.020
G091S	0.0020	0.66	6.6	340	0.12	0.120	28.9	25	59	23.8	0.23	0.08	1,305	1.17	11.6	15	0.090	0.080	2.0	1.2	0.080	0.20	84	0.020
H011S	0.0020	0.16	15.6	690	0.29	0.310	64.4	34	72	25.5	0.47	0.09	4,640	1.10	9.8	28	0.020	0.900	4.0	1.5	0.180	0.90	84	0.020
I196E	0.0020	0.05	63.4	173	0.01	0.120	25.5	22	32	15.2	0.24	0.06	995	1.00	12.5	7	0.140	0.760	2.0	0.8	0.025	0.10	92	0.030
H265S	0.0020	0.05	3.5	630	0.14	0.130	54.8	52	168	25.2	0.28	0.10	2,790	0.54	30.5	12	0.005	0.025	0.5	0.7	0.025	0.05	139	0.030
K085S	0.0020	0.38	13.2	150	0.09	0.150	25.7	43	39	19.5	0.16	0.07	1,395	0.72	18.6	7	0.020	0.380	2.0	0.9	0.050	0.30	100	0.040
I247S	0.0020	0.08	326.0	155	0.15	0.160	15.0	20	41	18.5	0.32	0.08	564	5.78	7.1	9	1.930	9.290	0.5	1.5	0.340	1.20	90	0.070
G184S	0.0010	0.03	16.6	118	0.48	0.350	18.5	16	38	16.1	0.16	0.11	1,215	1.32	4.7	10	0.050	1.120	0.5	1.3	0.290	0.40	94	0.010
L154E	0.0010	0.11	10.6	260	0.10	0.110	85.0	116	59	36.8	0.69	0.15	2,760	2.25	38.2	9	0.430	0.090	4.0	1.3	0.025	0.30	277	0.010
J148E	0.0010	0.09	6.3	156	0.10	0.120	74.2	108	49	29.8	0.22	0.14	2,560	0.41	36.7	10	0.005	0.100	2.0	0.7	0.025	0.05	316	0.010
J237S	0.0010	0.12	1.0	174	0.06	0.100	116.0	216	68	39.9	0.69	0.15	3,000	0.38	64.9	8	0.020	0.025	0.5	0.1	0.080	0.05	318	0.010
J143E	0.0010	0.07	3.5	137	0.08	0.110	81.9	114	50	31.3	0.24	0.15	2,570	0.24	40.7	10	0.005	0.060	2.0	0.6	0.025	0.05	332	0.010
K084E	0.0010	0.11	1.6	52	0.07	0.100	112.0	155	50	43.2	0.66	0.19	3,300	0.18	50.0	7	0.070	0.025	3.0	0.5	0.025	0.05	438	0.010
J301E	0.0010	0.09	5.9	148	0.33	3.610	12.4	7	60	16.2	0.18	0.12	1,990	0.61	6.1	15	0.060	0.270	2.0	1.2	0.150	0.30	688	0.010
G202S	0.0010	0.03	8.1	144	0.13	0.180	18.0	27	37	15.9	0.17	0.06	1,050	2.52	11.2	9	0.020	3.240	0.5	1.0	0.180	0.20	84	0.020
I106E	0.0010	0.06	35.9	165	0.11	0.075	21.5	33	36	19.3	0.37	0.06	909	0.91	13.2	9	0.090	1.065	2.0	1.0	0.080	0.85	79	0.040
L171E	0.0005	0.10	3.6	230	0.10	0.110	85.0	108	62	38.6	0.70	0.16	2,760	0.74	44.8	9	0.010	0.025	3.0	0.6	0.025	0.10	284	0.005
L175E	0.0005	0.09	1.6	188	0.03	0.150	72.2	73	59	31.7	0.71	0.15	2,440	0.12	32.3	7	0.010	0.025	2.0	0.5	0.025	0.10	315	0.005
L173E	0.0005	0.09	2.1	171	0.08	0.110	87.0	91	56	39.2	0.73	0.18	2,790	0.51	40.4	7	0.010	0.025	3.0	0.7	0.025	0.10	347	0.005
L149E	0.0005	0.15	4.8	195	0.09	0.120	94.3	133	62	39.2	0.76	0.15	2,730	1.09	48.1	9	0.010	0.050	4.0	0.8	0.025	0.20	291	0.010
J253E	0.0005	0.05	2.5	202	0.10	0.140	34.4	47	45	18.2	0.17	0.08	1,250	5.06	16.3	8	0.480	0.600	1.0	1.1	0.100	0.50	137	0.020
G127S	0.0005	0.06	3.6	201	0.08	0.130	75.4	70	62	28.4	0.30	0.10	2,620	0.35	32.6	8	0.005	0.025	1.0	0.3	0.025	0.10	292	0.020
G074S	0.0005	0.07	39.4	240	0.16	0.210	33.4	28	77	22.8	0.25	0.08	1,595	5.32	18.2	11	0.040	0.910	2.0	0.8	0.025	0.20	81	0.030
G075S	0.0005	0.06	33.8	310	0.13	0.240	31.5	32	84	23.4	0.25	0.08	1,715	6.54	18.6	12	0.030	2.840	2.0	1.0	0.070	0.50	84	0.030
G076S	0.0005	0.07	27.7	330	0.13	0.290	45.1	34	90	25.7	0.31	0.09	1,835	3.70	20.7	12	0.030	1.140	2.0	0.9	0.050	0.30	114	0.030
H239E	0.0005	0.10	13.5	132	0.04	0.320	23.2	88	44	16.1	0.23	0.07	1,405	0.51	29.5	105	0.005	0.230	1.0	0.7	0.025	0.20	148	0.030
L159E	0.0005	0.09	39.8	380	0.18	0.140	57.2	72	72	29.6	0.46	0.12	2,250	5.59	27.0	14	0.440	0.610	3.0	1.4	0.090	0.80	154	0.030
G069S	0.0005	0.07	48.7	300	0.18	0.280	33.8	38	80	25.7	0.23	0.10	1,820	2.27	21.5	12	0.030	1.150	2.0	0.8	0.025	0.20	88	0.070
J240S		0.09	2.5	320	0.10	0.110	71.0	106	76	31.1	0.44	0.12	2,390	0.24	37.3	10	0.005	0.025	0.5	0.4	0.090	0.10	204	0.010

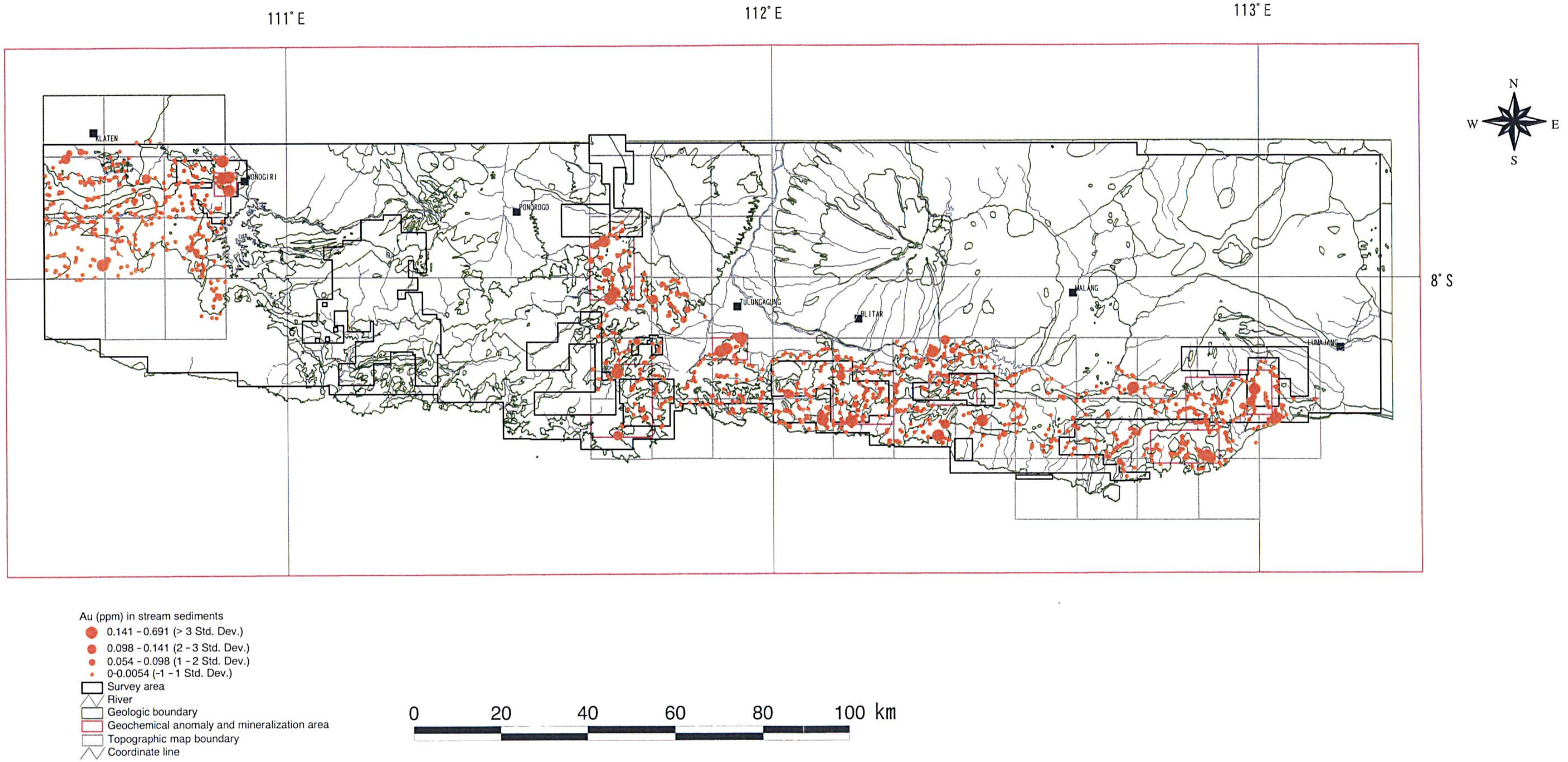


Fig. 3-23 Geochemical Anomaly of Stream Sediments (Au)

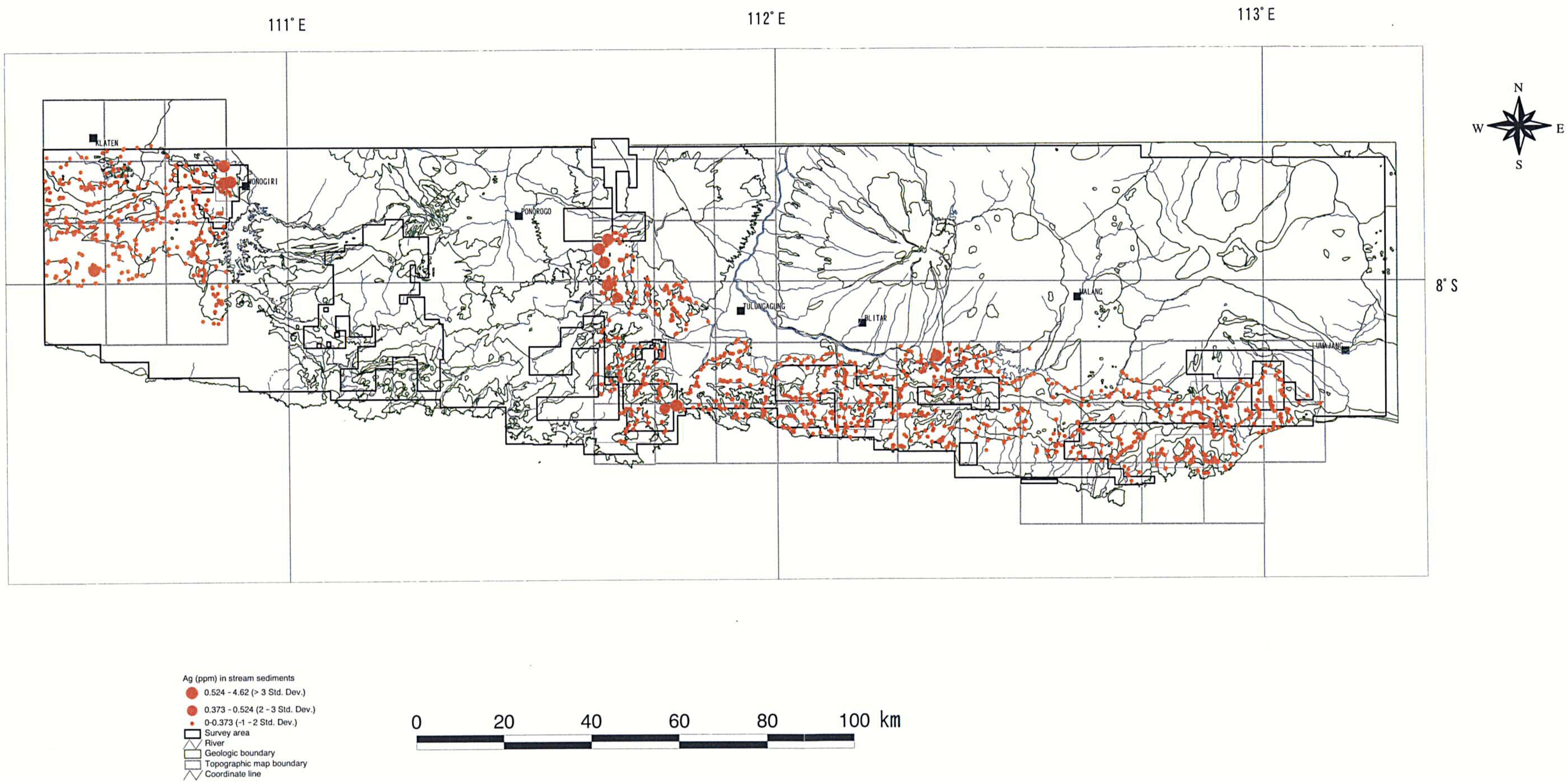


Fig. 3-24 Geochemical Anomaly of Stream Sediments (Ag)

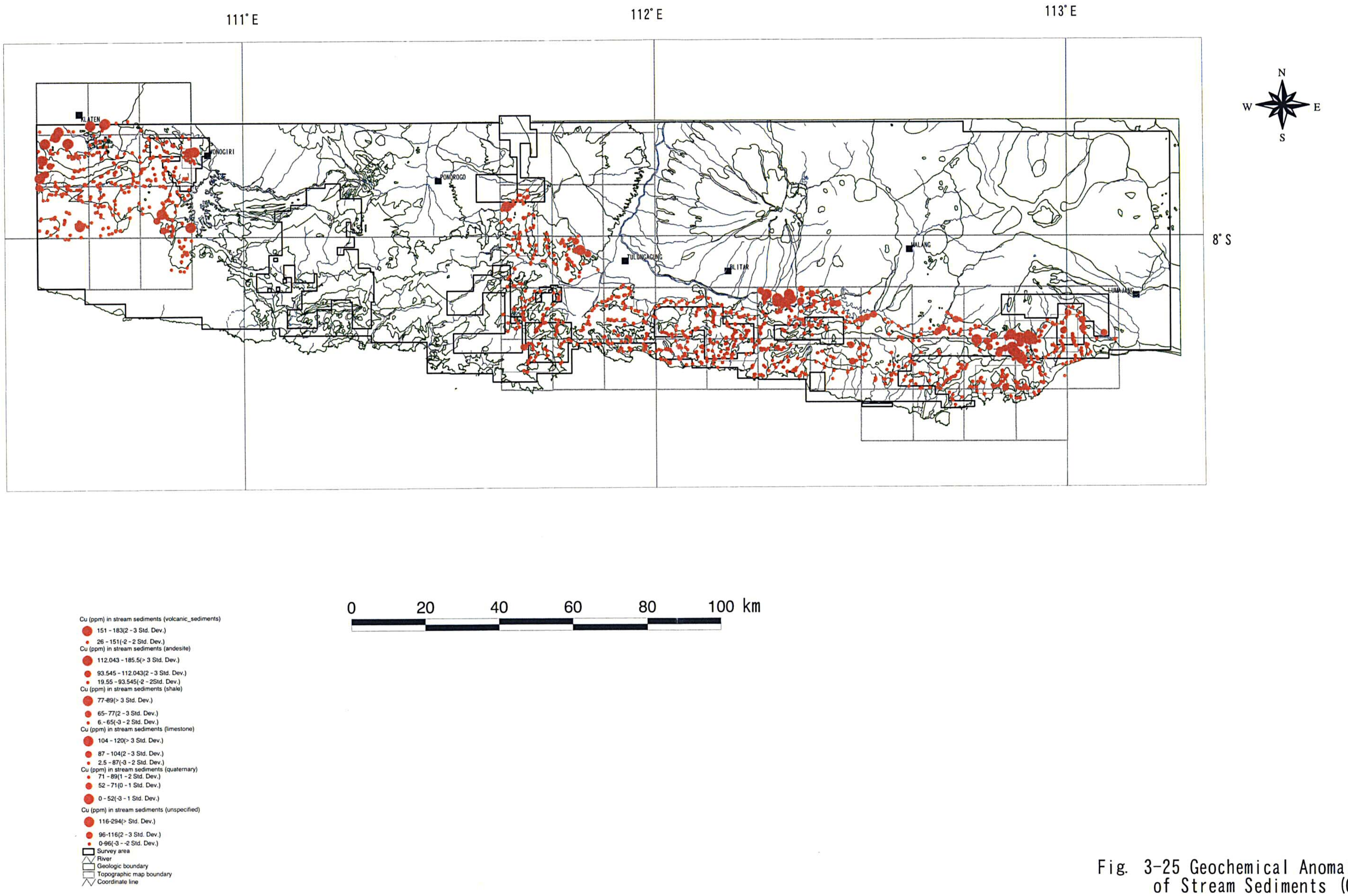


Fig. 3-25 Geochemical Anomaly of Stream Sediments (Cu)

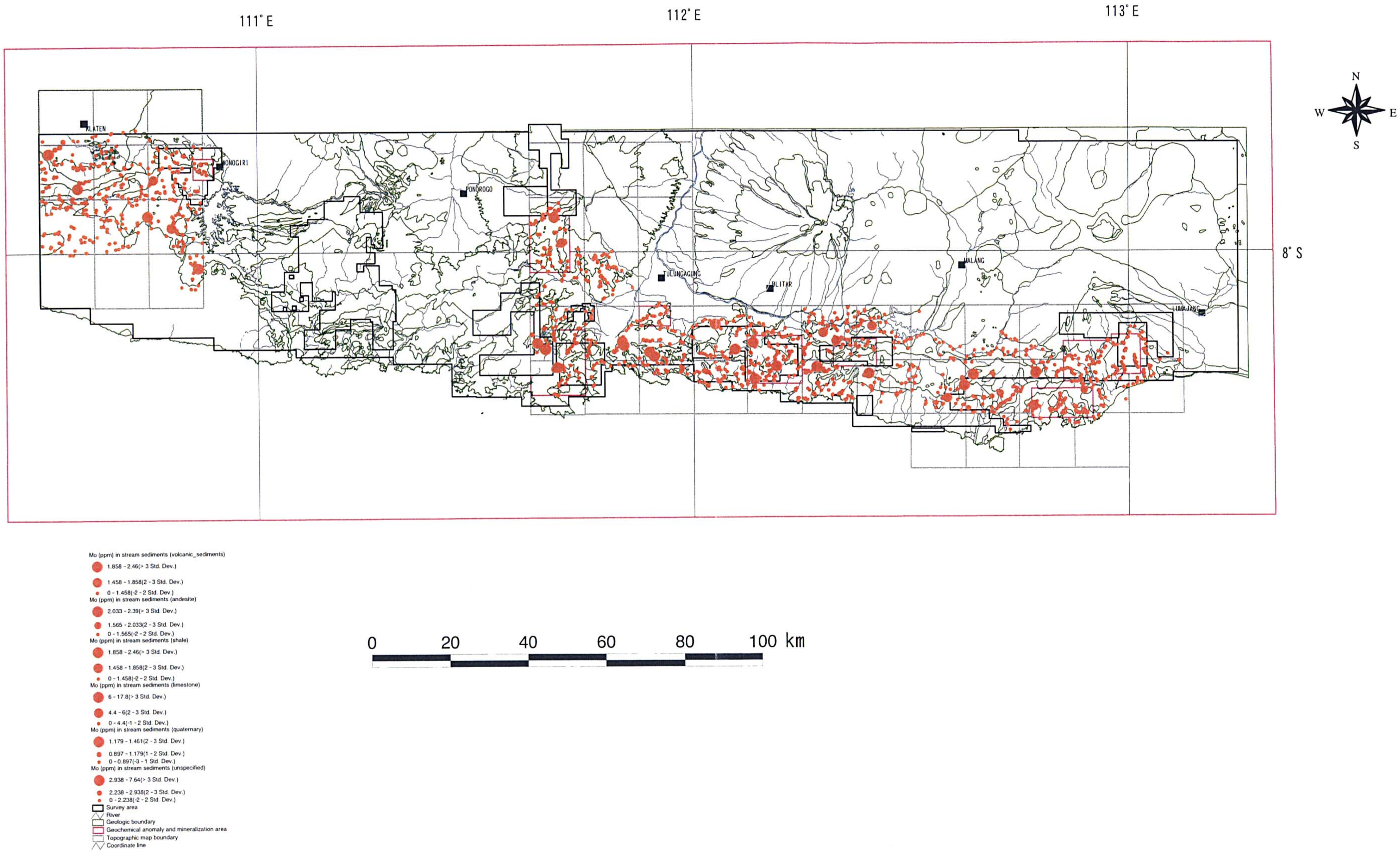


Fig. 3-26 Geochemical Anomaly of Stream Sediments (Mo)

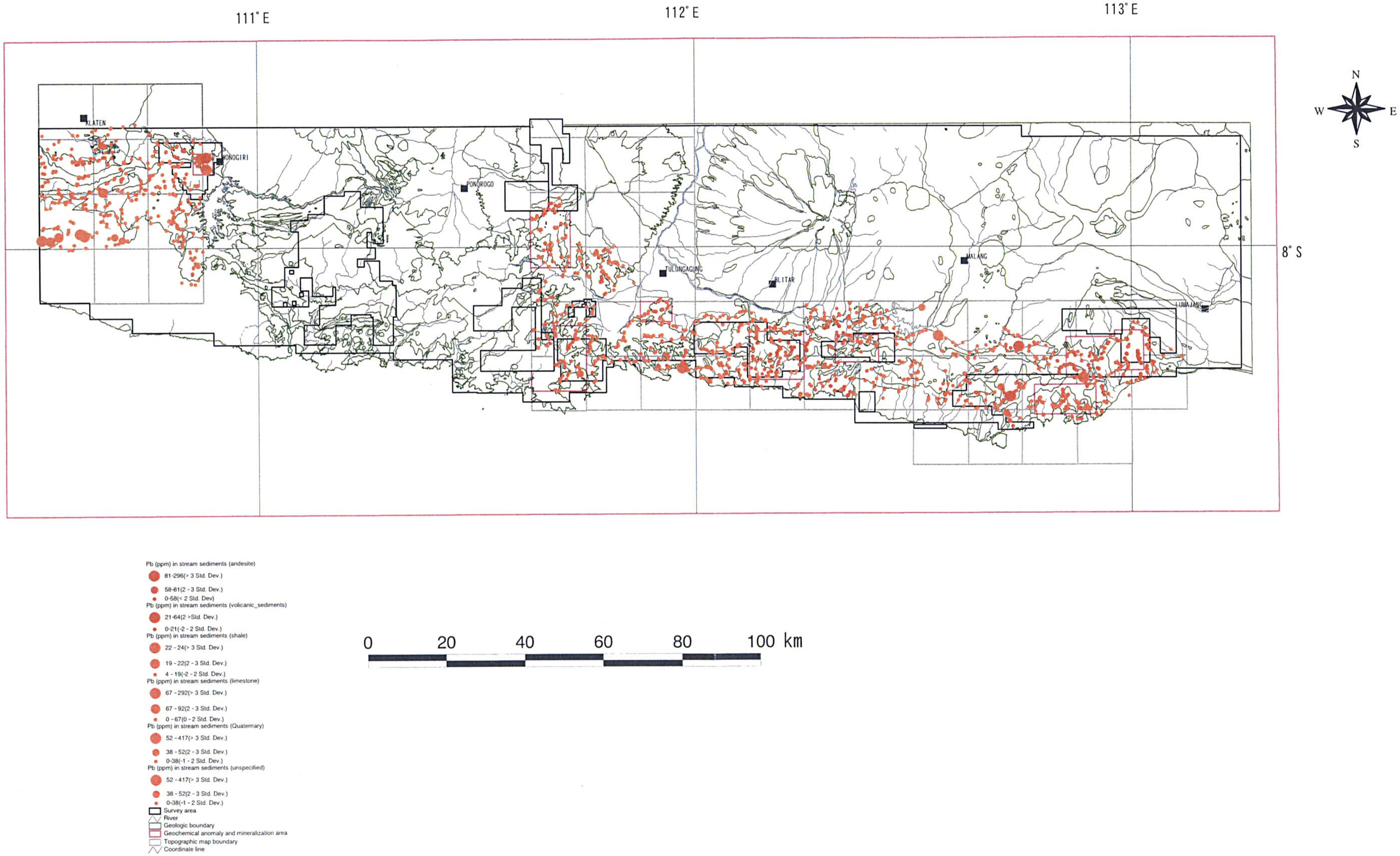


Fig. 3-27 Geochemical Anomaly of Stream Sediments (Pb)

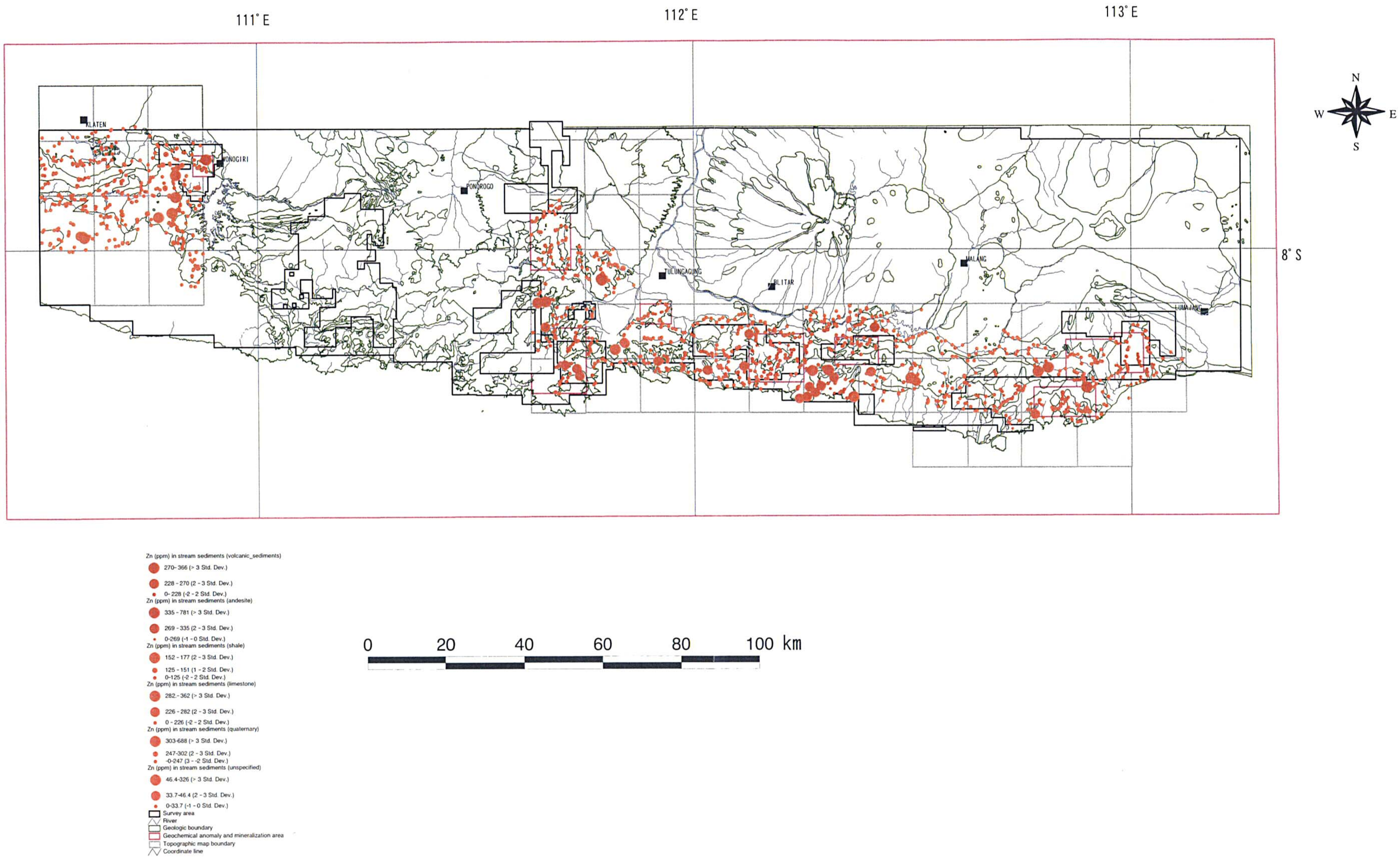


Fig. 3-28 Geochemical Anomaly of Stream Sediments (Zn)

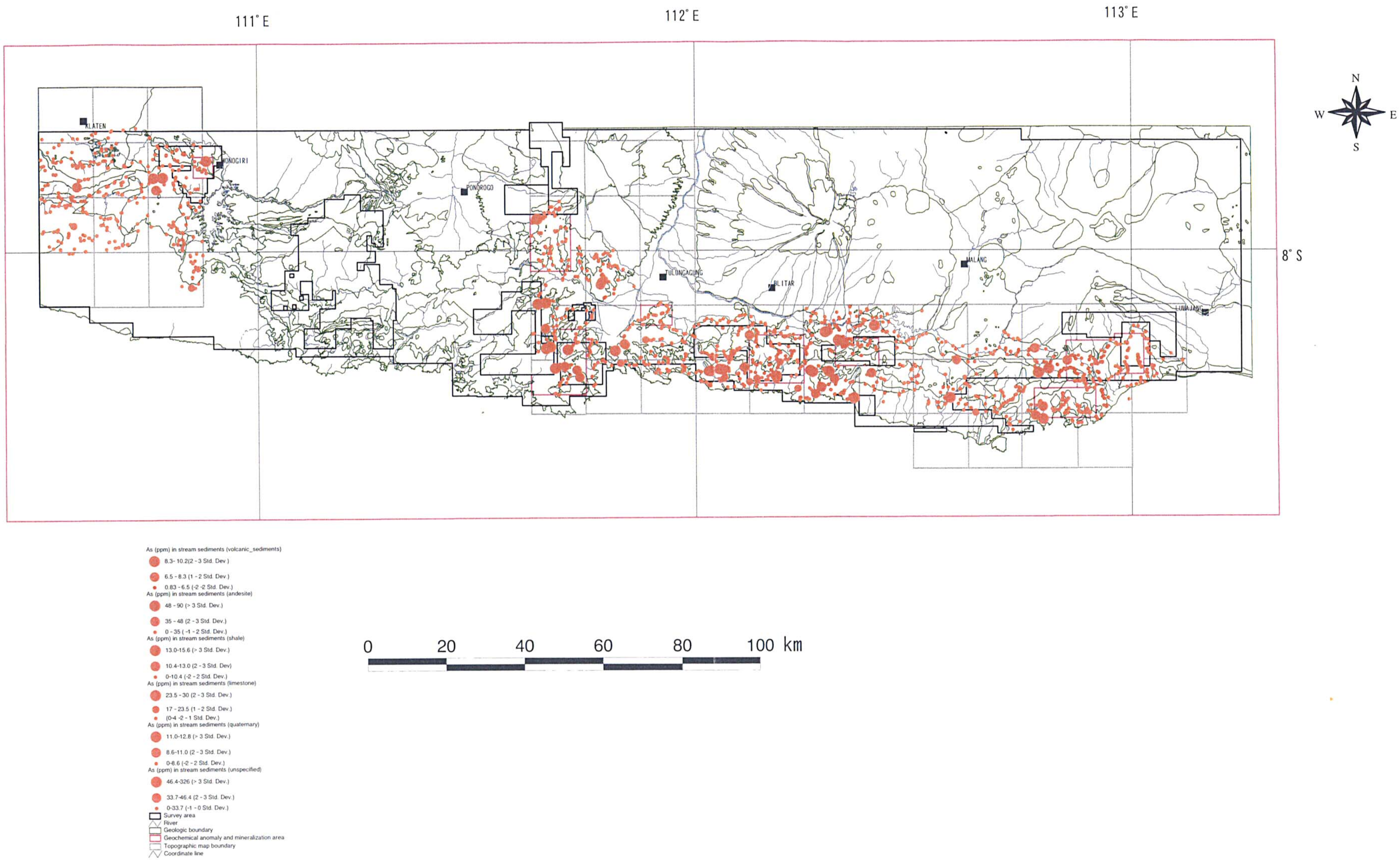


Fig. 3-29 Geochemical Anomaly of Stream Sediments (As)

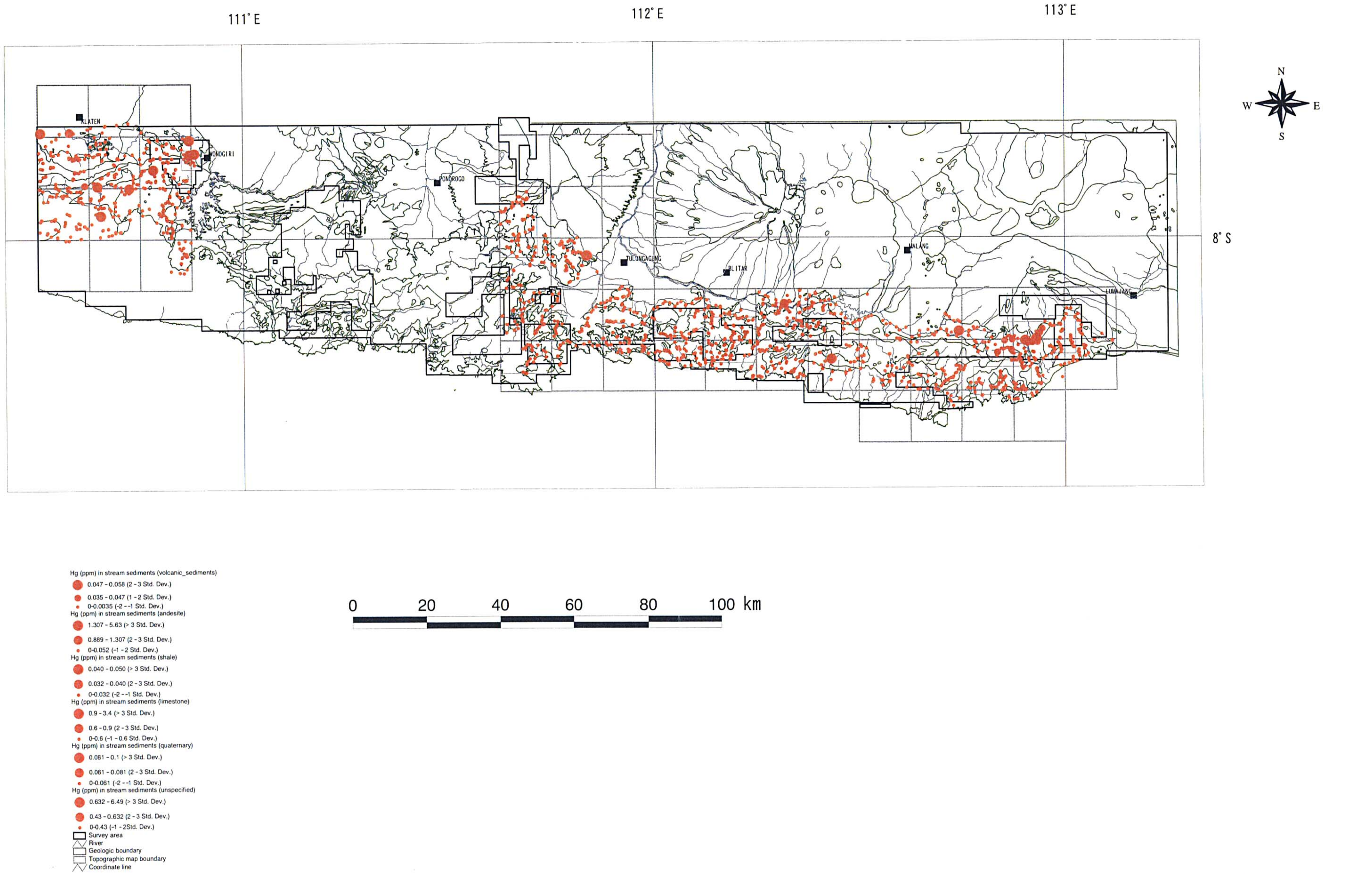


Fig. 3-30 Geochemical Anomaly of Stream Sediments (Hg)

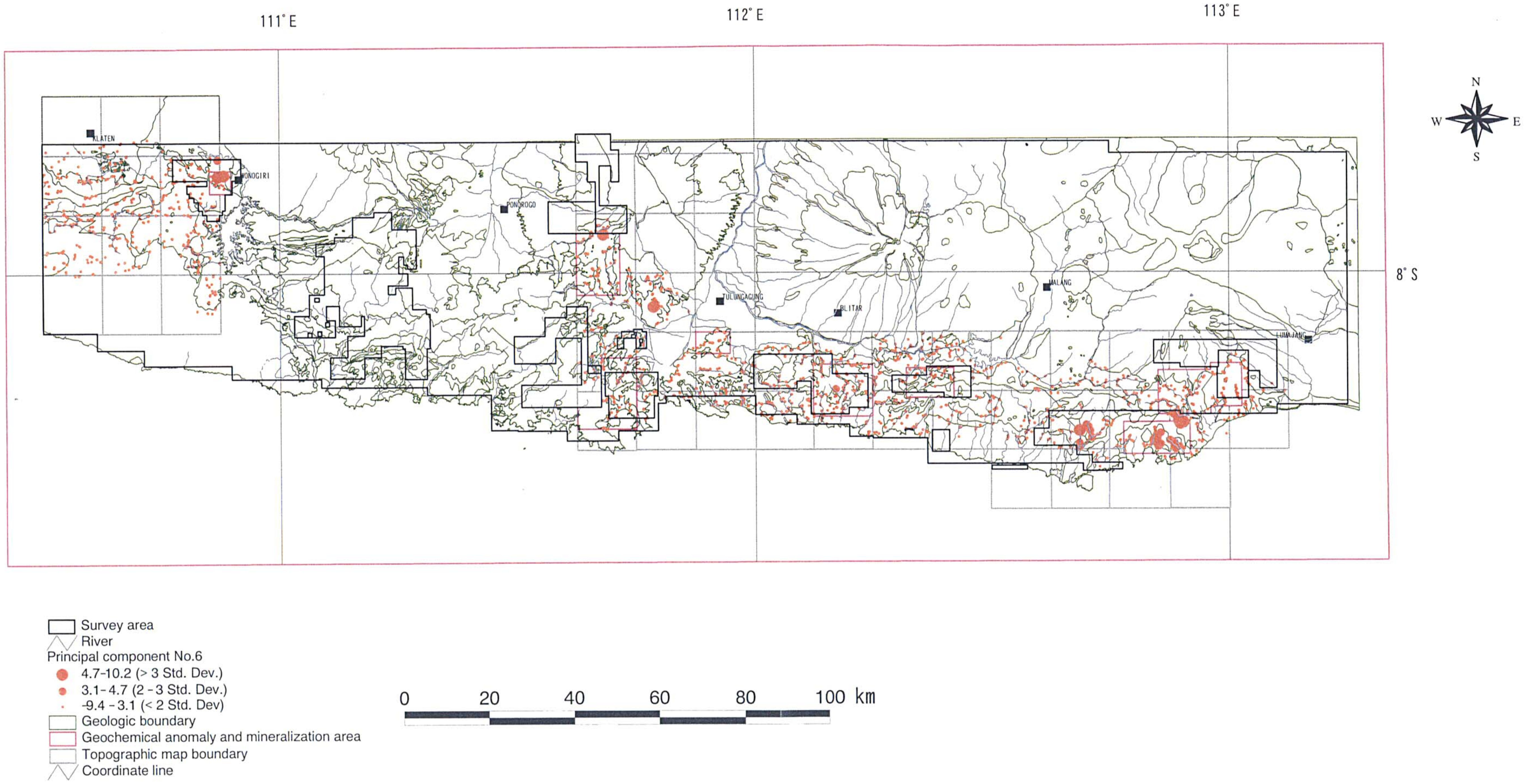
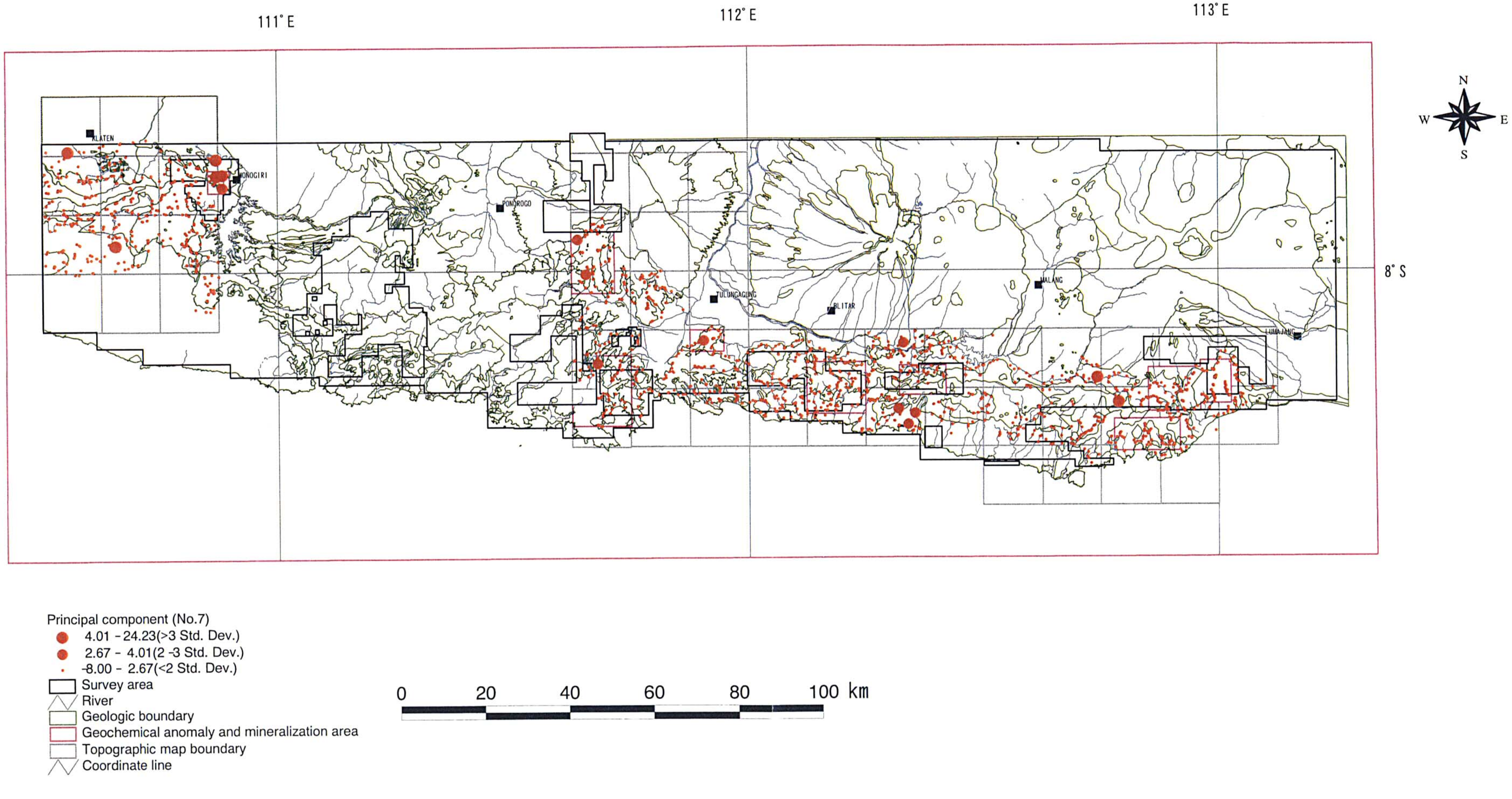


Fig. 3-31 Principal Component Analysis
(Principal Component No. 6)



TFig. 3-32 Principal Component Analysis
(Principal Component No. 7)

Chapter 3　Semi-detailed Geochemical Survey

Chapter 3　Semi-detailed Geochemical Survey

3-1　Method of Survey

A total of 497 sites were selected for geochemical sampling in the survey area covering 1,000km stream sediments of grain size below 166 mesh were sampled, and the elements shown in Table B-1 were analyzed.　Fig. 4-1 shows geological map in this area.
Rout maps were prepared based on 1:25,000 topographic maps. Survey routes were set after examination of existing geological data and considering the sampling sites for geochemical survey.
Stream sediments with grain size below 80 mesh were sampled at sampling position. These samples were dried on base camp after their drying, grain size below 166 mesh were sampled. Also duplicate samples were collected at 22 localities in order to check the error of samples. These samples were leached by four acid "near-total" digestion. Gold was determined by fire-assay and other elements by ICP.
Because of soil erosion, pan concentrate samples were also sampled at same position where stream sediments were sampled.

1) Dry panned-concentrate samples in the open air,

2) Weigh dried panned-concentrate sampled,

3) The magnetic mineral fractions, high magnetic minerals and medium-low magnetic minerals were removed by hand-magnet, separated out from the residue remaining non-magnetic concentrate fraction identified under binocular stereomicroscope. Au was determined by fire-assay and other elements by ICP. The results are laid out in Table 4-1 and Table B-2.

GPS was used for locating the position during the survey. Also sampling position, situation of stream, flow value and pH was also described. The results are appended in Table B-3.
The processing of collected samples was; rock thin section 3 samples, ore polished thin section 33 samples, X-ray powder refraction analysis 32 samples, fluid inclusion homogenization temperature and salinity measurement 24 samples.These results appended in Table B-4 to B-7.

3-2　Results of Geochemical Survey

(1) Results of analysis
The results area appended in Table B-1 . The statistics of the components are laid out in Table 4-2.

(2) Sampling errors
As seen in Figure 4-2 for duplicate samples, the analytical results of the elements with the exception of Au are judged to be within analytical errors. The analysis of overlapping samples of individual

sampling sites shows very close values with the exception of Au and Ag. The reason for the large fluctuation of Au values is inferred to be the "nugget effect".

(3) Correlation among elements

Au : As seen in Table 3 , Au has very weak correlation with Ag, As, Rb, Tl.
Ag : Ag has positive correlation with As, Bi, Pb, Te, Tl and W. Weak positive correlation also exists with Au, Cd, Rb, S, Sb, Zn and Hg.
Cu : Positive correlation exists with Bi, In and Zn.
Pb : Pb has strong positive correlation with Ag and Bi, also correlation exists with Cd, Rb, Tl, W and Zn.
Zn : There area very strongly correlation between Zn and Cd. Zn also has correlation with Mn and Pb.

(4) Distribution of anomalies by elements
From the analytical results, Au, Cu, Pb, Zn and As area considered to be the most effective indicator elements for Au, Ag, Cu, Pb and Zn mineralization of the survey area. Hg and Mo are considered to be effective pathfinders.
Each element variables were classified with four groups by their geology such as Oligocene-Miocene volcanics(TOMV), Oligocene-Miocene sediments(TOMS), Miocene volcanics(TMV) and Miocene sediments(TMS). Their thresholds were determined by method of Sinclair(1986)(Fig. 4-3).
Au (Fig. 4-4): Anomalous results were determined by up to 0.07ppm(TOMV), 0.107ppm(TOMS), 0.031ppm(TMV) and 0.013ppm(TMS). Anomalies occur Lorok-Kasihan district, Slahung and northern west of Kebonsari. These anomalies suggest quartz veins, mineralized zone and silicified zone distributes in Lorok and northern-west of Kebonsari. Tegalombo - Nawangan - Kebonsari area has high Cu anomalies. This anomaly is concerned with chalcopyrite-galena bearing quartz vein and mineralized zone.
Ag (Fig. 4-5): Anomalous results were determined by up to 0.7ppm(TOMV), 0.6ppm(TOMS), 0.29ppm(TMV) and 0.3ppm(TMS). Anomalies area occur around Kebonsari, Slahung, Kasihan, Lorok.
As (Fig. 4-6): Anomalous results were determined by up to 21.2ppm(TOMV), 61.7ppm(TOMS), 9.5ppm(TMV) and 16.9ppm(TMS). Anomalies occur from Pacitan to Lorok, northernwest Kebonsari, southern Kebonsari.
Hg (Fig. 4-7): Anomalous were determined by up to 0.188ppm(TOMV), 0.089ppm(TOMS), 0.036ppm(TMV) and 0.046ppm(TMS). Anomalies area appears Lorok district only.

Cu (Fig. 4-8): Anomalous results were higher than 150.3ppm(TOMV), 165.9ppm(TOMS), 92.2ppm(TMV) and 54.0ppm(TMS). Anomaly is spreading widly from Nawangan to Kasihan.

Pb (Fig. 4-9): Anomalous results were higher than 49.6ppm(TOMV), 157.7ppm(TOMS), 64.4ppm(TMV) and 41.6ppm(TMS). Anomalies appears around Kasihan, southerneast Kebonsari, around Nawangan and Slahung.

Zn (Fig. 4-10): Anomalies are higher than 310ppm(TOMV), 615.3ppm(TOMS), 224.5ppm(TMV) and 165.9ppm(TMS). Strong anomalies occur Kasihan - Lorok area and north Kebonsari. Zn anomaly is also developing widely in Nawangan area.

Mo (Fig. 4-11): Anomalies are higher than 2.54ppm(TOMV), 3.25ppm(TOMS), 1.245ppm(TMV) and 1.55ppm(TMS). Anomalies occur Tegalombo-Kasihan-Lorok and east Pacitan.

3-3 Discussions

The anomalies occur in the following 6 districts, 1) Slahung district(Ponorogo South district), A2) Kasihan district, 3) Lorok district, A3) Pacitan district, A4) NW Kebonsari district (Purwoharjo district), A5) Nawangan district (Figure 4-12).

1) Ponorogo South district : In Ponorogo south district, Au and Ag anomalies were detected. Pb anomaly is weak. Quartz veins and silicified rock zone exists in this district. Gold, silver and lead anomalies result from these zones.

2) Kasihan district : Copper, lead and zinc anomalies appear strongly in Kasihan district. In the stream at west side Kasihan, stream water pH indicate between 3 and 4 and Iron oxides also were precipitated. Around Kasihan village, old copper mining was carried out by adit, and copper oxides yield around this adit. In 1993, Korea Mining Promotion Corporation and Directorate of Mineral Resources did geological survey and drilling survey around Kasihan, but they did not continue to explore mineral resources in this area. So, it seems that mineralized zone does not distribute widely.

3) Lorok district : In Lorok district, Au, Ag and As anomalies were detected. Around Lorok, quartz veins area accompanied with argillized alteration. Quartz vein contains gold(30g/t max) and silver(788g/t max). Quartz-Kaolinite clay minerals assemblage suggests strongly that hydrothermal alteration is distributed in this district.

4) Pacitan district : Pacitan district is characterized by strong As anomalies. Also, Ag and Mo anomalies were detected. Silicified rock floats with galena and chalcopyrite were scattered in streams. Gold occur in pan-concentrates. The features described above suggests there are mineralized zone in the further upper streams.

5) NW Kebonsari district(Purwoharjo district) : Au, Ag and As anomalies were detected. Quartz veins exists in this area, the veins has a E-W to ENE-WSW strike. Gold particles occur in

pan-concentrate samples.

6) Nawangan district : Copper and Zinc anomalies were detected in this district. Quartz vein and mineralized vein outcrop in central Nawangan. These veins contain chalcopyrite, galena and sphalerite. PT. Aneka Tambang has a mining concessions around this area.

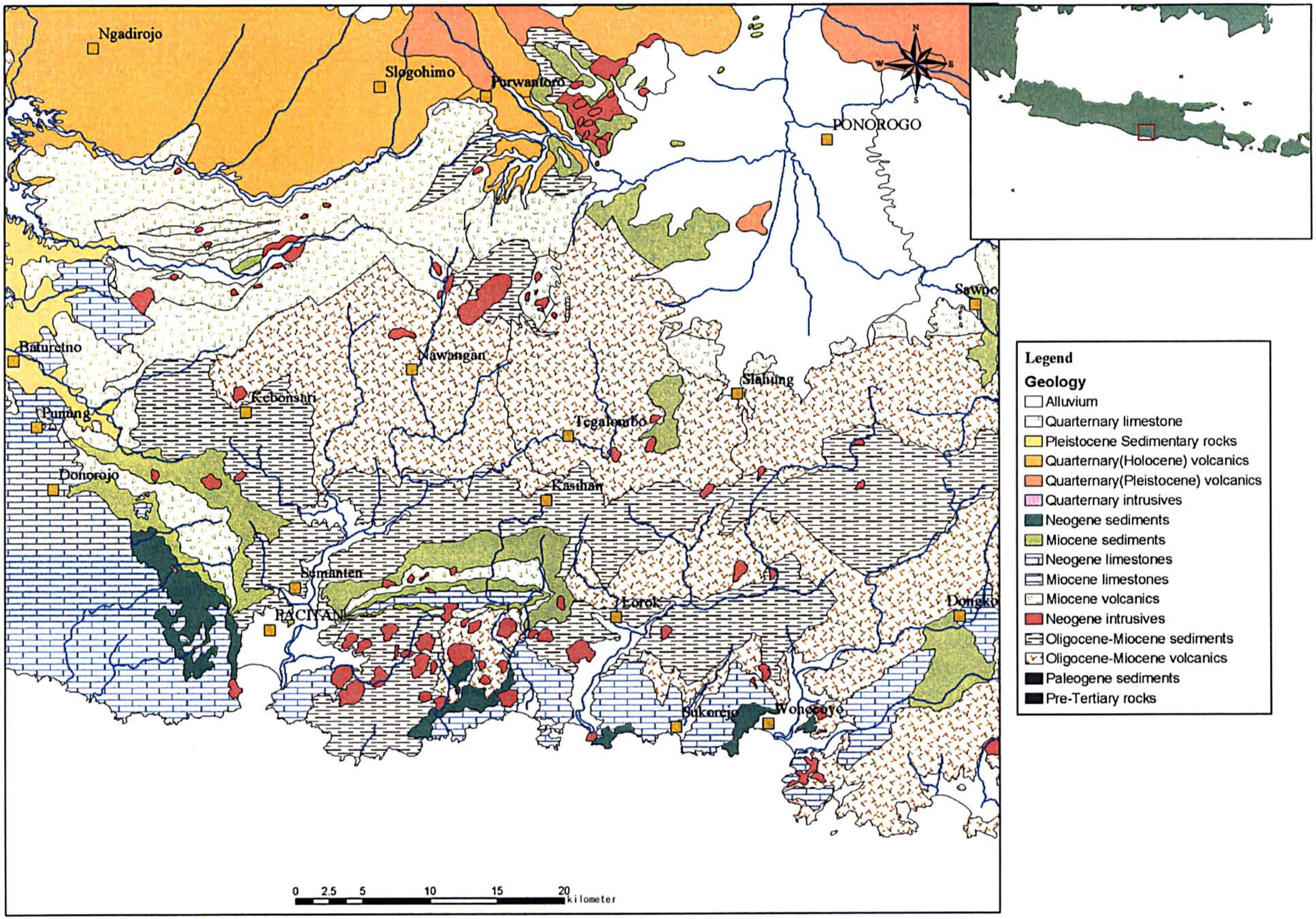


Fig. 4-1 Geological map of Semi-detailed Survey Area

Table 4-1 Heavy Minerals Identified by Panning of Stream Sediments (1/3)

Sample	weight(g)	Magnetite	Ilmenite	Iron Oxide	Epidote	Amphibole	Pyroxene	Garnet	Corundum	Leucoxene	Chalcopyrite	Zircon	Anatase	Barite	Pyrite	Quartz	Argentite	Markasite	Chlorite	Wolframite	Rock fragment	Galena	Glass	Arsenopyrite	Sphalerite	Bornite	Gold
A001	39.52	76.11	5.82	0.38	TR		13.21				TR			0.17	1.78	2.45						0.04	0.01				
A002	72.15	82.34	10.03	0.2	0.72		7.29							0.02	TR	0.37							0.02				
A003	27.9	76.8		1.1	TR		20.97							0.02	TR	1.08											
A004	42.25	83.36	0.81	TR			15.44					TR		TR	TR	0.3								TR			
A005	56.54	88.96	0.52	TR			10.04					TR		TR	0.04	0.39						TR		TR			
A007	79.28	88	0.11	TR	TR	0.23	11.26							TR		0.32							0.02				
A008	51.78	76.09	0.42	0.21	TR	0.42	20.25				TR				TR	2.58						TR					
A009	61.84	38	12.05	0.6		1.2	46.41					TR			TR							1.71					
A011	170.19	85.78	4.24	0.002		TR	9.9								TR	0.04						TR		TR			
A012	108.22	83.62	0.16	TR		TR	16.18				TR			TR	0.002	0.02							0.08				1VFC
A013	39.52	62.29	TR	TR		0.36	35.99									0.75											
A021	72.15	86.63	TR	0.195		0.46	11.07				TR				TR	1.61											
A022	27.9	82.85	0.63	1.63	TR	0.25	10.51				TR	TR			0.67	3.81						TR		TR		TR	
A023	42.25	84.9	TR	TR	TR	TR	13.43					0.06			TR	0.99											
A024	56.54	14.33	0.16	4.95	TR	TR	2.36								32.92	44.36								0.82		TR	2VFC
A025	33.83	64.43	TR	0.49	TR	0.95	30.67					TR			0.18	3.25											
A027	53.84	77.54	TR			0.42	20.71					TR			TR	1.29											
A029	52.29	64.29	22.02	3.56	TR		8.53								TR	1.41											
A030	15.64	51.85	7.75	23.24	TR	TR	7.74					TR			TR	9.39											
A031	91.81	74.37	4.12	0.45	TR	0.45	17.87					TR			TR	2.71											
A032	130.31	65.77	24.32	0.3	TR	TR	5.83					TR	TR			3.57											
A033	360.14	79.09	17.03	TR		0.89	TR								2.83	0.14											
A034	1096.01	88.95	7.74	TR		1.94	TR					TR			0.01	1.34											
A035	88.19	87.31	3.92	TR		1.78	TR					TR			0.27	6.7											
A036	37.54	73.6	22.1	TR		0.4	0.23					TR			0.22	3.4											
A037	303.11	91.64	4.65	0.05	0.27		TR					TR			0.11	3.25											
A046	35.55	60.5	32.08	TR			5.66								TR	1.65											
A052	2.58	89.53	2.01	TR			5.03					TR			TR	3.34											
A053	51.73	95.36	1.13	TR			3.39				TR	0.004			0.04	0.06											
A054	4.87	49.6	12.37	4.94			19.79								12.41	0.78											
A056	8.75	59.42	1.59	1.59			23.99					TR			10.36	3											
A058	48.45	85.73	2.75	TR			11.03					0.01			0.01	0.45											
A060	60.48	91.05	3.55	TR			5.32					TR			0.005	0.06											
A065	4.79	37.16	1.84	7.39		TR	27.71								6.42	19.41											
A069	17.32	65.24	1.53	18.36			10.71					TR			1.04	3.11											
A072	23.23	49.72	39.63	2.13			0.85								7.13			TR									
A073	12.19	46.26	13.15	TR			22.54								18.03												
A077	24.84	39.33	1.608	19.29			8.04								21.37									TR			
A079	7.2	43.88	1.81	7.25			10.87					TR									28.74			TR			
A081	26.47	72.15	4.75	TR			19.19			TR		0.07			3.72									TR			
A083	20.39	72.43	1.89	1.65			17.76				TR	TR		0.11	3.98	2.13											
A084	27.48	72.05	2.15	1.07			16.18				TR				4.7	3.82											
A087	5	74.4	8.82	0.37			9.2					TR			0.72	7.03											
A088	11.03	62.82	13.02	0.42	TR		9.64								3.57	10.44											
A091	68.69	4.8	TR	88.09			1.19					0.59				5.29											
A094	24.97	72.6	4.67	TR			17.54								2.71	2.4						TR					
A095	5.78	48.26	15.64	3.91			11.73							0.63	10.34	9.47											
A096	13.15	59.84	6.5	13.02			11.39								1.76	7.22											
A097	7.73	63.64	7.31	TR			23.86								2.66	2.47											
A098	2.6	35.38	8.65	3.36			19.03								1.49	31.45											
A100	63.74	1.88	0.28	0.46			0.28					TR			87.72	9.23			0.12			TR					
A101	7.79	75.86	6.2	1.03			13.02					TR			1.04	2.42				0.41							
A102	12.52	76.83	10.62	0.63			9.56				TR	TR			1.18	1.15											
A103	3.3	58.18	14.24	2.84			11.3					TR			2.66	10.66											
A105	71.03	70.8	TR	TR		23.82	TR					TR			0.03	1.25								4.02			
A106	23.92	73.53	1.2	TR		9.64	13.26					TR			TR	2.34											
A107	515.53	68.51	6.85	TR		10.96	8.22								0.08	5.3											
A108	46.04	81.08	TR	TR		8.93	7.31					TR			0.01	2.66											
A110	6.06	66.96	24.42	TR	TR		8.14					TR			0.03	0.44											
A111	48.81	85.39	4.06	7.02			2.81					0.01			0.14	0.56											1FC
A112	33.25	77.86	5.08	0.41	TR		14.43	TR				TR			0.54	1.68											
A113	69.96	84.59	8.05	0.73			5.86					0.02		TR		0.74						TR					1VFC
A114	15.66	78.09	1.02	TR			19.35					TR			TR	1.53											
A115	24.78	74.82	3.61	1.21			19.31								0.02	1.03											
A116	22.97	80.06	1.72	TR			15.55					TR			0.39	2.26											
A117	77.06	74.56	6.95	TR		0.49	17.38									0.59											
A118	57.52	98.99	0.68	TR	TR		0.17					TR				0.16											
A119	54.03	92.09	4.33	TR	TR	TR	3.54								TR	0.04											
A120	45.78	95.32	4.17	TR	TR		0.46					0.01			0.01	0.03											
A121	49.63	91.87	7.29	0.24	TR		0.56								TR	0.02											
A124	17.17	76	3.62	0.2		0.2	15.72					TR			0.59	3.65											
A125	15.22	73.06	5.5	TR		TR	14.31								0.25	6.88											
A126	40.06	33.67		4.61	TR		0.33				TR				60.96	0.43											
A130	5.41	24		4.43	0.92	TR	17.74					TR			32.6	18.96											
A131	4.17	28.45		6.69	6.69	TR	20.07					TR			4.35	34.13											
A133	6.02	66.94	1.52	1.52	12.15	TR	12.15								0.66	1.99											
A134	3.81	13.38		20.68	23.26		2.58								19.16	20.94								TR			
A135	3.9	13.8	1.6	13.4	34.9										26.36	9.6											
A136	5.97	28.3	1.79		1.79		12.55				TR	TR			46.6	8.96											
A137	3.5	38.14	2.42	4.85	9.71		7.28								32.85	5.71											
A138	18.22	79.36	1.02	0.61		0.4	17.3					TR			1.03	0.26											
A139	8.15	72.02	5.11	6.82	TR		3.41								9.9	2.73											
A140	44.11	74.11	0.75	1.25		0.5	22.56					TR				0.82											
A141	48.73	79.39	0.9	7.74	0.9	TR	9.06				TR	TR			0.74	1.24											
A142	13.1	68.77	3.38	7.06	0.84	TR	16.94					TR			0.15	2.82								TR			
A143	39.84	70.38	1.11	2.22	8.86	0.44	9.53				TR	TR			1.86	5.59						TR		TR			
A144	50.54	74.93	1.19	2.39	0.47	0.72	19.17								TR	1.11											
A147	26.76	65.28	1.25	4.98	3.11	TR	21.81					TR			TR	3.55											
A148	74.01	83.11	3.05	3.87	0.76	1.52	6.1								0.02	1.61											
A150	18.84	72.98	2.55	0.76	0.76	0.51	20.93								TR	1.48											
A152	75.62	70.44	1.29	2.58	2.58	0.52	18.83				TR				0.03	3.72											
A153	24.11	58.35	0.47	1.17	TR		21.75				TR				0.36	17.88											
A155	16.04	38.28	3.1	6.21			17.07				TR				21.47	13.8											
A157	38.48	70.45	TR	1.43	0.57	0.85	25.72								0.01	0.95										TR	
A159	13.92	76.79	2.06	3.01	1.03	1.03	13.4					TR			TR	2.58											
A163	10.78	76.15	3.35	2.23	1.11		15.65					TR			TR	1.48											
A165	28.25	80.35	4.61	1.84	12	TR	11.98					TR			TR	1.2											
A167	16.29	52.79	6.81	1.7		TR	25.55								TR	13.13											
A169	75.15	83.8	2.75	TR		8.137	7.42								0.02	2.42											
A170	51.15	76.48	5.7	1.14	1.14	0.46	14.37								0.04	0.7											
A171	28.21	75.32	4.47	0.2	TR	0.41	15.26				TR				0.22	4.11											1VFC
A172	11.06	18.89	3.61	7.22	TR	TR	16.23								18	36.02											
A173	4.01	69.32	2.79	0.83		0.55	23.74								0.68	2.06											
A175	38.47	81.36	1.65	0.49	0.82	0.33	13.18								TR	2.15											
A176	16.11	81.99	5.1	0.85	TR		11.05								TR	0.99											
A177	54.2	73.63	6.25	1.25	7.5		9.99								0.27	1.1											
A178	11.61	63.82	5.47	2.72		TR	19.05								1.79	7.2				TR							
A180	33.61	65.16	7.5	0.6	0.9	1.5	19.5								TR	4.8											
A181	8.1	75.93	4.91	3.92	0.98	TR	9.8					TR			0.44	3.99											
A182	18.09	52.68	9.2	7.87	0.78		7.08								13.9	8.42											
A183	9.24	76.19	2.9	1.93			14.52					TR			1.33	3.11											
B001	20.07	94.61	0.09	TR	TR	0.149	4.7					TR			0.04	0.39											
B002	29.64	91.1	0.86	TR	TR	TR	7.77								TR	0.1											
B003	11.42	94.48	0.05	TR	TR	TR	0.08								TR	0.08											
B004	60.27	91.12	0.17	TR	TR	TR	0.5				TR	TR			TR	0.19											
B005	76.72	40.5	TR	TR		TR	55.28								TR	4.2											
B006	66.72	63.96	0.17	TR		TR	35.25					TR			TR	0.55						TR					
B007	78.08	34.25	1.28	TR		TR	62.84									1.63											
B008	42.03	34.47	1.28	TR		0.64	62.76								TR	1.09											
B009	52.65	91.03	TR	TR			67.9									2.16											
B010	30.53	33.18	0.64	TR		1.29	62.9								TR	1.96											
B011	34.61	54.57	TR	TR		0.78	41.3								TR	3.32											
B012	96.31	28.08	TR	TR			70.38								TR	1.52											
B014	72.36	87.07	4.46	TR		TR	6.69					TR			TR	1.77											
B015	7.65	83.5	0.14	TR	TR	TR	13.29								TR	1.53											
B016	52.54	81	7.48	TR	TR	TR	11.22								TR	0.24											
B017	25.35	79.84	4.95			0.99	13.86		TR						TR	0.35											
B018	67.64	79.64	5.03	TR	TR	TR	15.11								TR	0.2											
B019	38.31	79.5	1.02	TR		TR	19.4								TR	0.05											
B020	9.03	37.09	5.03	5.03		TR	23.48				TR				10.27	19.07						TR					
B021	54.09	4.05	0.14	0.33		TR	0.67								76.96	17.83								TR			2VFC
B022	16.42	74.78	15.2	1.16		TR	7.01					TR			0.09	1.74											
B024	24.38	84.86	6.91	0.27		TR	6.63				TR				0.13	1.18											
B025	18.32	89.19	0.79	TR		TR	7.12								1.15	1.73											
B026	79.02	67.21	9.49	TR	TR		22.14								0.03	1.11											
B028	33.74	78.63	15.53	1.94	TR		1.94								TR	1.95								TR			
B029	4.64	77.8	0.12	0.5	TR		12.11				TR	TR			0.75	8.73											
B030	55.96	89.05	7.03	0.87	TR		0.88				TR	TR			0.22	1.75											
B031	48.64	71.99	4.8	14.4	TR		4.8				TR	0.04		0.16	2.4	1.32								TR			2VFC-FC

Table 4-1 Heavy Minerals Identified by Panning of Stream Sediments (2/3)

Sample	weight(g)	Magnetite	Ilmenite	Iron Oxide	Epidote	Amphibole	Pyroxene	Garnet	Corundum	Leucoxene	Chalcopyrite	Zircon	Anatase	Barite	Pyrite	Quartz	Argentite	Markasite	Chlorite	Wolframite	Rock fragment	Galena	Glass	Arsenopyrite	Sphalerite	Bornite	Gold
B032	69.48	73.11	0.5				21.04					TR		TR	TR	5.35								TR			
B033	45.89	63.02	2.69	TR	TR		24.22				TR	0.1		0.1	6.54	3.22						TR		TR		TR	
B034	116.89	65.78	14.26	9.07	TR		2.59				TR	TR		TR	6.62	1.66						TR		TR			1VFC
B035	31.79	68.76	13.79	13.24	TR		0.55				TR	TR		TR	0.91	2.73								TR			
B036	10.07	49.75	3.72	27.82	TR		5.58								3.25	9.75								TR			
B037	21.67	67.42	14.06	8.2	TR		1.17					TR		0.18		3.01								TR			5.93
B038	9.12	62.61	TR	TR	TR		24.78					TR			TR	12.61											
B039	13.08	62.61	1.63	TR	TR		31.15					TR			0.13	4.58											
B040	82.99	59.18	39.62	0.4			TR					TR			0.01	0.76											
B042	16.84	83.13	0.42	TR			13.47					TR			0.03	2.94											
B043	17.95	62.33	1.61	0.21	TR	0.64	30.1					TR			TR	5.08											
B044	8.39	59.71	2.7	4.02		27.07						TR			TR	6.44	TR										
B046	115.43	90.46	2.47	2.88	TR		2.47					TR			TR	1.68											
B047	14.07	47.05	TR	TR	TR		29.03					0.22		0.22	6.9	16.56								TR			1VVFC
B048	44.01	89.72	0.176	0.49	TR		8.99					TR		TR	0.01	1.43											
B050	15.9	70.18	TR	1.23	TR		23.42				TR	0.1		TR	0.41	4.64	TR					TR					
B052	12.39	83.72	0.22	0.87	TR		9.87				TR	TR		TR	1.05	4.19											
B053	12.84	79.59	1.79	0.35	TR		15.76					TR			TR	2.49											
B057	42.02	17.01	78.34	TR			TR					TR			TR	4.64											
B058	69.53	69.59	28.69	TR			TR					TR			TR	1.71											
B059	36.38	49.4	47.69	TR			TR					TR			TR	2.88											
B060	80.08	29.53	61.29	TR			TR					TR			TR	9.17											
B061	17.98	29.53	61.29	TR			TR								TR	9.17											
B062	59.25	13.67	82.43	TR	TR	TR	0.41								TR	3.48											
B064	64.34	63.87	27.75	1.73			3.47							TR	2.01	1.14											
B065	5.7	86.66	6.04	0.23			5.13								0.38	0.58											
B066	46.34	55.54	42.49	TR			2.18			TR					0.77												
B067	26.85	41.08	57.03	TR			0.28					TR			0.17	1.6											
B068	30.22	73.39	2.17	TR			9.48					TR			14.39	0.6											
B069	45.77	82.14	11.27				4.33					0.01		TR	20	0.22											
B070	73.29	75.74	23.74	TR			TR								0.12	0.3		TR									
B071	18.52	65.22	27.68	TR	TR		6.92							TR	1.28	1.43					0.14						
B072	10.07	59.98	15.95	TR			19.49					TR			TR	4.56											
B073	18.43	78.18	3.08	TR			17.15					TR			0.03	1.59											
B074	19.57	49.36	44.41	TR			2.33					TR		TR	0.03	3.84											
B075	10.72	87.49	2.48	TR			9.92					TR			0.02	0.06											
B076	4.34	87.32	3.73	TR			8.7							TR	0.05	0.17					0.14						
B077	10.76	89.31	2.89	TR			6.76					TR			0.05	0.97											
B078	12.75	87.21	2.66	TR	TR		7.99								0.02	2.07		0.02									
B079	14.93	89.55	4.1	TR	TR		6.14								0.09	0.11											1FC
B080	3.05	82.29	2.31	TR			13.09					TR			0.01	2.28											
B081	33.09	93.5	12.4	0.06			4.92					TR		0.005	0.08	0.26											
B082	6.1	70.33	7.09	5.67			14.18					TR			1.75	0.98											
B084	35.5	8.11	7.45	TR			4.01					TR			0.08	0.33		TR									
B085	44.35	85	4.19	TR			9.78				TR	TR		TR	0.2	0.81											
B086	29.45	80.98	1.82				16.44					TR		TR	0.03	0.7											
B087	3.66	62.29	5.39		TR		15.1	TR				TR		0.8	11.54	4.83											
B090	25.64	55.26	38.59		TR		0.43	TR				TR			4.36	1.29											
B091	27.95	46.9	50.37		TR			2.65				TR			8.03	0.039											
B092	16.65	32.19	60.66	TR	TR		TR							TR	0.71	6.43											
B093	24.7	72.75	4.84	4.84			9.68					TR		TR	5.9	1.97											
B094	15.36	70.96	16.96	TR			9.13					TR		0.8	0.15	2.78											
B095	25.73	70.62	24.24	TR			4.2					TR			0.06	0.76											
B096	9.27	79.72	6.72	TR			11.9					TR			0.42	1.16											
B098	8.56	76.52	6.3	TR			13.66					TR			1.1	2.27											
B099	29.8	45.3	50.24	TR			0.5					0.03			1.32	2.56						TR					
B100	36.8	71.79	22.5	TR			2.65					TR			1.57	1.455											
B101	37.37	89.46	3.13	0.21	TR	TR	7.11		TR			TR			TR	0.08											
B102	29.63	93.72	0.93	TR	TR	TR	5.27								0.006	0.06											
B103	14.24	87.49	2.36	0.35	TR	0.24	0.85								TR	0.7											
B104	17.6	89.14	1.57	0.52	TR	TR	8.41					TR			TR	0.34											1MC, 1FC
B105	47.49	86.04	0.38	2.07	TR	TR	10.34		TR			TR			0.03	0.14											
B107	20.48	67.48	10.78	0.62	TR	0.92	18.48								TR	1.71											
B108	67.88	73.43	6.49	1.3	TR	TR	18.18								TR	0.59											
B109	38.61	40.92	3.05	TR	TR		57.89								TR	0.73											
B110	30.65	24.53	3.7	TR	TR		70.32					TR			TR	1.44											
B111	57.5	61.76	1.11	TR	TR	0.74	35.1				TR				0.13	1.17						TR		TR			
B112	60.72	54.54	2.22	TR			42.27								TR	0.95											
B113	57.17	56.27	TR	TR		TR	41.91								TR	1.82								TR			
B114	52.94	70.23	15.73	0.28	0.57	TR	12.01					TR			TR	1.17											
B115	67.23	48.72	0.53	TR	1.06	TR	51.85								0.04	1.39								TR			1VVFC
B116	71.37	37.2	TR	TR	TR	TR	60.32								TR	2.49											
B117	104.45	73.95	0.74	TR		0.5	23.37								TR	1.44											
B118	67.76	83.99	TR	0.15		TR	15.15					TR			TR	0.72											
B119	129.74	85.05	TR	TR	TR	0.28	14									0.66											
B120	114.17	90.22	TR	TR	TR	0.18	9.06									0.53											
B121	87.4	77.92	TR	TR	TR	TR	20.6									1.46											
B122	33.39	40.91	TR			1.08	53.59									4.4											
B123	89.36	23.7	28.59	7.13	TR	TR	35.67				TR				0.42	0.63								TR		TR	
B124	46.62	33.7	28.54	7.13	TR	TR	36.67				TR				0.15	4.81										TR	
B125	52.63	77.61	1.29	0.25	TR	1.032	23.25								TR	2.55											
B126	61.68	78.4	6.25	TR	TR	TR	14.57								TR	1.07											
B127	37.71	33.41	39.72	19.88	TR		6.62									0.06											
B128	153.81	81.58	7.11	1.77	TR	0.35	8.53								TR	0.66											
B129	22.92	66.36	0.98	TR		0.64	30.58								TR	1.44											
B130	54.47	83.8	0.46	TR		0.31	14.66		TR			TR			0.02	0.73								TR			
B131	50.12	94.13	0.55	TR		TR	4.92					TR			TR	0.39											1VVFC, 1VFC
B132	67.17	93.33	0.12	0.06	TR	0.12	5.74				TR	TR			0.03	0.59						TR					1FC
B133	102.42	83.55	3.14	TR	TR	TR	12.57								TR	0.73											
B134	54.6	73.35	0.77	TR		TR	25.12								TR	0.75											
B135	13.69	73.48	5	TR	TR	TR	20.04								TR	1.46											
B136	50.78	81.8	0.67	TR			12.77								TR	0.166											
B137	17.99	86.38	0.67	TR			12.77								TR	0.166											
B138	29.3	77.06	3.31	TR	TR	0.22	18.55								TR	0.85											
B139	14.59	48.8	0.92	9.19	1.37	TR	34.49								TR	5.21											
B140	28.43	87.16	1.57	0.52	TR		8.41								TR	2.32											
B141	13.5	82.52	0.76	0.31	0.4	TR	13.73								TR	2.22											
B142	11.58	80.74	0.55	TR	TR	TR	18.1																				
B143	13.54	71.42	0.55	0.55	0.27	TR	26.24				TR	TR			0.1	0.86											1FC
B144	40.86	60.72	1.23	20.56	TR	TR	16.02								0.12	0.12											
B145	6.29	61.36	7.98	0.32	1.27	1.59	20.77								TR	6.67											
B146	12.34	41.97	TR	53.65			2.82								TR	1.54											
B147	11.77	69.16	0.56	10.65	TR	TR	16.82				TR				0.28	2.52											
B148	12.56	79.6	0.72			TR	17.35								0.05	2.26											
B149	15.66	80.27	1.39	0.35	0.52	0.34	14.82								TR	2.29											
B150	17.2	29.3	2.8	59.35			5.61				TR				2.92												
B152	5.29	77.5	1	TR	TR									TR	0.61	1.84											
B153	4.63	82.25	0.2				16.29							TR	TR	0.65											
B154	21.84	82.32	1.6	TR	TR	0.32	14.1								TR	1.65											
B155	20.33	88.98	1.55	TR		TR	8.78								TR	0.68											
B156	14.79	50.1	3.84	5.76	TR	TR	28.8								TR	11.49											
B157	9.89	76.54	1.42	0.41	TR	0.2	18.29				TR				1.72	1.41											
B158	13.54	67.65	1.15	0.23	TR	0.92	20.67								0.37	9								TR			
B160	12.41	87.1	2.82	TR	TR	TR	8.46				TR				0.4	1.21								TR			
B161	5.29	46.5	10.49	2.09	1.25	0.84	26.85					TR		0.57	0.57	10.37				0.42							
B162	33.02	53.36	0.42	9.98	8.32	TR	22.88				TR	TR		TR	0.2	4.83						TR		TR			1VFC
B163	76.4	71.06	2.06	5.66	3.86	TR	14.16				TR				0.79	2.4								TR			
B164	18.43	72.22	10.89	TR	TR	TR	16.34				TR				0.03	0.5						TR					
B165	14.39	76.99	8.92	TR	TR	TR	13.38				TR	TR			0.42	0.27						TR					
B166	16	88.8	2.67	TR			8.02				TR	TR			0.075	0.43											
B167	22.24	88.26	3.79	0.11	TR	TR	6.93								0.17	0.8											
B168	14.41	83.76	4.97	TR	0.75	TR	9.7								0.03	1.3											
B169	89.44	89.44	3.42	TR	0.3	0.2	5.85								0.08	0.2											
B171	27.28	89.88	3.35	TR	0.38	0.09	5.74								0.05	0.49											
B172	37.66	86.51	6.55	0.655	0.65	TR	5.25								0.02	0.35											
B173	36.86	86.54	4.49	0.26	0.12	TR	7.95								TR	0.62											
C002	16.56	52.53	4.17	TR		TR	37.6					TR			TR	5.6											
C003	34.56	90	2.74	0.91		TR	5.48					TR			0.04	0.74											
C004	94.49	94.9	1	TR		TR	40					TR			TR	0.05											
C005	195.49	16.8	81.85	TR			TR					TR			0.06	1.25								TR			
C006	41.17	55.67	43.67	TR			TR					TR			0.03	0.62											
C007	50.16	1.016		0.2			0.3				TR		4.9		94.02							TR		TR			2VFC
C008	8.21	76.49	TR	TR		TR	19.61					TR			0.04	3.25											
C009	17.53	5.76	TR	22.89			1.01				TR	TR			70.31							TR		TR			
C010	9.33	86	0.54	TR	TR	TR	12.2				TR	TR			0.01	1.06											
C011	25.13	6.6	TR	55.65			0.22								19.74	17.74											
C012	11.78	85.75	0.61	TR			11.69				TR	TR			0.05	0.88								TR			
C013	7.89	67	2.64	0.64			23.84				TR				2.58	3.23											
C014	8.75	65.02	3.19	TR	TR		28.79					TR			0.06	2.912											
C016	12.25	64.32	2.32	TR	TR		29.68					TR			0.187	3.56											

Table 4-1 Heavy Minerals Identified by Panning of Stream Sediments (3/3)

Sample	weight(g)	Magnetite	Ilmenite	Iron Oxide	Epidote	Amphibole	Pyroxene	Garnet	Corundum	Leucoxene	Chalcopyrite	Zircon	Anatase	Barite	Pyrite	Quartz	Argentite	Markasite	Chlorite	Wolframite	Rock fragment	Galena	Glass	Arsenopyrite	Sphalerite	Bornite	Gold
C017	10.3	83.88	1.196	1.16	TR		12.71					TR			0.06	0.99											
C018	13.96	77	2.1	1.08	TR	TR	17.9				TR	TR			0.038	1.86						TR					
C019	10.71	69.74	2.18	1.09	TR		24.07					TR			0.08	2.8											
C020	22.72	71.08	TR	16.13	2.48		6.2					TR			0.2	3.88											
C021	3.5	52.28	0.8	1.21	36.25		2.01					TR			0.07	7.35											
C022	47.93	62.21	1.26	5.64	0.75		19.96	0.5				TR		TR	0.62	8.76				0.25							
C023	19.55	88.22	0.2	0.1	TR		9.7				TR	TR			0.52	1.21											
C024	10.42	69.28	0.26	TR	TR	0.26	26.05				TR				0.04	3.87											
C025	19.52	51.58	0.34	19.3	TR		18.82							TR	0.67	2.37											
C026	17.42	78.18	1.84	4.93	TR		11.97							TR	0.67	2.37											
C027	10.58	55.82	1.24	3.65	1.24	TR	19.8					TR			0.78	37.6											
C028	15.52	74.81	0.17	TR			16.96									8.05											
C029	13.97	57.05	4.86	TR		0.64	25.94					TR			1.2	10.31											
C030	8.33	45.73	14.92	4.26			17.04								8.71	9.31											
C032	13.55	75.72	1.05	TR		1.05	18.99								TR	3.17											
C033	7.87	51.33	8.8	0.59	0.86		18.57				TR			1.98	8.5	1.9											
C034	5.73	57.76	5.78			7.71	24.68					TR			1.3	2.75											
C035	11	60.72	3.4	TR	1.7		28.97							0.05	0.1	5.02											
C036	6.94	10.66	1.19	4.78	2.39		8.37				TR				46.42	26.16											
C037	12.69	38.69	2.32	2.08	31.2							TR			2.32	6.97											
C040	14.04	53.98	25.78	3.96			9.92					TR			2.53	3.8											
C041	50.33	77.99	8.35	TR			10.2								0.69	2.27											
C042	8.57	62.42	5.62	1.41			20.52					TR			2.45	7.56											
C043	17.4	52.79	3.59	17.98			14.93					TR		0.11	1.58	9.62											
C044	29.27	68.46	3.19	0.79			10.57					TR			TR	16.89											
C047	17.54	57.46	6.67	1.66			25					TR			0.09	9.1											
C049	13.41	47.35	13	14.64			9.15					TR		TR	0.96	15.1											
C051	19.46	42.24	20.16	TR			22.4							0.13	5.35	9.71											
C052	3.32	53	13.97	0.69	TR		19.91					TR			3.95	8.43											
C056	655.41	87.7	12.13	0.06			TR					TR			TR	0.07											
C058	131.05	84.19	14.5	TR			0.77					TR			TR	0.45											
C060	26.29	81.39	6.92	0.35			10.03					TR			0.19	1.09											
C061	27.69	84.97	7.42	TR	TR		6.07					TR			TR	1.52											
C062	54.81	86.13	5.76	0.5			6.4					TR			0.17	1						TR					
C063	26.55	76.16	4.79	1.99	0.99		11.97					TR			0.2	3.88											
C064	29.05	82.85	6.25	0.7			8.28					TR			0.38	1.44											
C065	24.56	78.7	8.77	0.39			9.75					TR			0.58	1.79											
C077	18.27	70.5	1.84	0.92	0.92		14.71																				
C078	19.41	68.83	4.17	0.88	0.83		TR					TR			TR	3.01											
C079	12.24	65.27	1.39	7.69	0.55	TR	18.94								TR	6.54											
C080	21.09	69.37	2.92	0.14	0.58	TR	25.7																				
C082	52.93	46.13	5.08	TR	TR	TR	45.79								TR	2.98											
C083	26.19	15.19	4.03	TR	TR		77.62								TR	3.09											
C084	9.94	25.05	3.36	TR	TR		63.84					TR			TR	7.14											
C085	22.84	54.59	1.59	0.39		TR	38.08									5.32											
C086	36.82	27.18	1.31	TR	TR	TR	66.19								TR	5.3											
C087	30.76	58.22	13.33	TR	TR	1.91	23.41								TR	3.12											
C088	21.63	85.76	1.74	TR	TR	TR	9.9								0.13	2.46											
C089	18.23	45.25	4.27	TR	0.47		4.74								11.31	33.94											
C090	56.56	71.31	8.17	TR	TR		9.99								0.128	0.38											
C091	49.91	78.6	6.27	0.69	0.27	TR	6.69				TR				5.96	1.49								TR			
C092	51.15	80.02	16.52				1.85					TR			0.95	0.5											
C093	10.53	80.91	4.38	3.65	2.92	TR	3.65				TR				TR	4.46										TR	
C094	42.15	88.09	4.42	0.33			6.37		TR		TR				TR	0.74						TR					
C095	70.2	45.58	0.37	7.52			10.9				TR				23.14	12.46				TR				TR			1FC
C096	28.11	78.44	2.58	7.38	2.76		2.76				TR			0.06	0.93	2.1						TR		TR			
C097	133.07	90.92	TR	6.43	0.4		1.21					TR			TR	1.03											
C098	37.14	93.53	1.28	0.128	TR	TR	4.99		TR			TR			TR	0.05											
C099	155.94	94.26	4	0.11	TR	0.16	1.06								0.02												
C100	35.35	92.14	3.11	0.38	TR	TR	2.72								1.57	0.06						TR					
C101	73.13	92.9	3.06	0.136	TR	TR	3.54					TR			0.17	0.2						TR					
C102	17.7	93.16	2.29	TR	TR	0.33	3.93		TR			TR			0.005	0.27											1FC
C103	47.33	91.27	3.44	TR	TR	TR	5.16								0.006	0.12											
C104	18.67	73.16	4.33	5.42	TR	TR	5.42								8.83	2.82											
C105	14.36	89.13	2.13	4.26	TR	TR	1.6								2.74	0.13											
C106	23.17	67.32	4.85	4.85	1.21	TR	7.27									5.05											
C107	40.72	91.52	3.31	1.07	0.16		3.72								0.01	0.18											
C108	74.79	89.82	4	1	0.5	TR	4.5								0.02	0.16											
C109	29.24	83.27	5.66	0.81	TR	0.81	8.89								TR	0.55											
C110	18.01	83.28	2.49	0.16	0.66	TR	9.05				TR	TR			TR	0.11				0.33				TR			
C111	12.85	87.78	3.01	TR	TR	TR	9.05				TR	TR				0.15		TR									
C112	20.72	87.35	3.6	0.6	0.6	TR	7.21								TR	0.63											
C113	340.27	94.92	TR	0.73	0.42	1.22	2.68									0.2											
C114	30.16	76.55	1.11	4.57	1.11	2.23	13.37								TR	1.04											
C115	22.36	85.24	2.12	0.42	0.28	TR	11.31								TR	0.626											
C116	37.77	90.15	7.83	TR	TR		1.96								TR	0.05											
C118	13.55	77.5	0.88	TR	TR		21.11								TR	0.52											
C119	10.65	81.13	1.87	TR	TR	TR	16.9								TR	0.09											
C120	41.25	81.21	2.62	TR	0.35	0.52	13.92								TR	1.33											
C121	62.93	88.38	1.05	0.1	0.21	0.21	8.97									1.06											
C122	78.13	90.5	3.19	0.45	0.09	TR	5.37								TR	0.38											
C123	19.4	79.79	0.52	0.17	0.17	0.34	16.25								TR	2.73											
C124	5.09	86.44	0.39	0.26	0.26	0.39	11.85									0.39											
C125	14.47	76.57	1.61	0.6	0.8	1	16.08									3.32											
C126	18.73	74.64	18.94	TR	TR	TR	6.31									0.11											
C127	6.69	87.44	5.75	TR	0.57	TR	4.6								1.36	0.05											
C128	16.77	78.89	15.92	TR	TR		10.61								0.05	0.48		TR									
C129	154.49	84.53	13.39	0.15	TR		1.34					TR			0.26	0.32											1MC
C130	71.14	90.61	4.18	TR	TR	TR	5.11								0.01	0.08											
C131	18.68	71.73	11.13	TR	TR	TR	16.7					TR			0.02	0.41											
C132	90.06	67.85	4.78	6.37	TR		3.18				TR			0.32	16.18	1.29						TR		TR	TR		
C133	12.98	71.64	8.22	5.87	TR		7.05								0.38	4.12											
C134	8.61	86.87	5.64	1.25	TR	TR	4.39								1.41	0.46											
C135	7.49	29.51	5.82	11.64	TR	TR	7.28								29.16	16.55											
C136	44.19	51.68	8.39	8.39		TR	3.14								22.91	5.47											
C137	12.19	75.22	8.82	0.39	TR	TR	10.19								3.03	2.33											
C138	8.18	76.41	7.36	1.05	TR		12.19								0.8	2.18											
C139	49.75	91.11	4.85	0.08	0.44		3.44								0.003	0.06											
C140	36.04	85.68	7.79	0.71	TR	TR	5.67								0.01	0.13											
C141	48.66	91.26	3.76	TR	TR		4.6					TR			0.01	0.36											

Table 4-2 Statistics Data of Geochemical Analysis

	Au(ppm)	Ag(ppm)	Al(%)	As(ppm)	Ba(ppm)	Be(ppm)	Bi(ppm)	Ca(%)	Cd(ppm)	Ce(ppm)	Co(ppm)	Cr(ppm)
Maximum	<0.001	<0.02	4.49	<0.2	18.9	0.21	<0.01	0.06	0.03	9.39	4.6	1.0
Minimun	0.588	2.62	11.00	148.0	1010.0	1.94	5.86	11.05	5.99	47.2	60.6	367.0
n	497	497	497	497	497	497	497	497	497	497	497	497
Mean	0.0150	0.119	7.944	7.60	188.14	0.710	0.228	0.941	0.382	19.776	21.86	19.1
Median	0.0040	0.070	8.010	3.10	174.00	0.710	0.120	0.600	0.200	19.700	21.20	12.0
Standard deviation	0.0409	0.224	1.088	17.20	87.33	0.190	0.560	1.117	0.577	4.658	8.69	24.3
variation	0.0017	0.050	1.185	295.92	7626.21	0.036	0.314	1.247	0.333	21.699	75.45	592.4
Skewness	7.9104	7.334	-0.317	5.78	3.76	0.822	7.470	4.555	5.414	0.581	0.58	7.4
Kurtosis	88.5195	66.146	0.375	37.34	27.00	3.618	60.446	28.814	38.792	1.931	0.65	87.6

	Cs(ppm)	Cu(ppm)	Fe(%)	Ga(ppm)	Ge(ppm)	Hf(ppm)	In(ppm)	K(%)	La(ppm)	Li(ppm)	Mg(%)	Mn(ppm)
Maximum	0.15	8.4	2.26	9.55	0.09	0.3	0.036	0.10	4.0	3.0	0.18	53.0
Minimun	8.51	232.0	22.7	30.4	0.72	5.1	0.635	2.06	21.2	40.8	2.65	6960.0
n	497	497	497	497	497	497	497	497	497	497	497	497
Mean	1.220	51.40	6.66	18.89	0.232	2.171	0.100	0.78	8.9	9.9	0.98	1357.2
Median	0.930	43.90	6.48	18.60	0.230	2.100	0.086	0.74	8.6	8.9	0.87	1230.0
Standard deviation	1.043	32.63	2.27	3.16	0.068	0.800	0.060	0.35	2.2	4.7	0.46	637.2
variation	1.087	1064.5	5.15	9.96	0.005	0.640	0.004	0.12	4.9	22.3	0.22	406047
Skewness	2.830	2.12	1.54	0.39	1.408	0.466	4.533	0.56	0.8	2.8	1.30	3.0
Kurtosis	10.237	6.35	6.45	0.58	6.570	0.231	28.294	0.29	1.9	12.7	1.82	18.5

	Mo(ppm)	Na(%)	Nb(ppm)	Ni(ppm)	P(ppm)	Pb(ppm)	Rb(ppm)	Re(ppm)	S(%)	Sb(ppm)	Se(ppm)	Sn(ppm)
Maximum	0.025	0.06	0.10	0.70	100.0	2.60	3.7	<0.002	<0.01	<0.05	<1	0.4
Minimun	10.9	2.74	4.00	61.5	990.0	832.00	108.5	0.028	1.38	46.0	11	3.0
n	497	497	497	497	497	497	497	497	497	497	497	497
Mean	0.878	0.668	1.47	10.02	388.9	24.63	18.8	0.002	0.072	0.330	1.6	1.044
Median	0.660	0.620	1.30	7.60	380.0	11.80	17.0	0.001	0.020	0.070	2.0	1.000
Standard deviation	0.947	0.413	0.91	7.92	135.7	59.14	11.3	0.002	0.162	2.220	0.7	0.373
variation	0.897	0.171	0.83	62.68	18410	3497.49	128.0	0.000	0.026	4.928	0.5	0.139
Skewness	5.539	0.892	0.56	2.42	0.6	8.33	4.6	9.012	5.433	18.120	4.7	1.759
Kurtosis	44.066	0.980	-0.60	7.80	0.9	87.47	30.7	138.243	33.930	361.418	56.2	5.379

	Sr(ppm)	Ta(ppm)	Te(ppm)	Th(ppm)	Ti(%)	Tl(ppm)	U(ppm)	V(ppm)	W(ppm)	Y(ppm)
Maximum	14.9	<0.05	<0.05	0.6	0.11	0.04	0.2	21	<0.1	6.70
Minimun	876.0	0.26	1.54	6.6	1.67	2.29	2.3	1080	14.8	39.6
n	497	497	497	497	497	497	497	497	497	497
Mean	104.7	0.068	0.098	1.916	0.55	0.256	0.6	223.2	0.282	18.82
Median	80.2	0.025	0.050	1.800	0.53	0.210	0.6	208.0	0.200	19.00
Standard deviation	87.0	0.059	0.166	0.797	0.19	0.232	0.3	107.9	0.763	5.50
variation	7565.3	0.003	0.028	0.635	0.04	0.054	0.1	11640	0.583	30.21
Skewness	3.8	1.241	4.856	1.561	1.26	4.871	1.3	1.9	15.064	0.26
Kurtosis	22.4	0.547	28.653	5.282	3.92	31.206	4.0	9.0	268.71	0.06

	Zn(ppm)	Zr(ppm)	Hg(ppm)
Maximum	23	11.2	<0.01
Minimun	1610	166.0	1.10
n	497	497	497
Mean	156.2	74.46	0.0298
Median	133.0	72.70	0.0100
Standard deviation	113.5	30.31	0.0829
variation	12885.9	918.46	0.0069
Skewness	6.5	0.49	8.5950
Kurtosis	66.9	0.03	86.1392

Table 4-3 Correlations between Elements of Geochemical Samples

	Au	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr	Hg
Au	1.00																																																
Ag	0.27	1.00																																															
Al	-0.04	-0.02	1.00																																														
As	0.21	0.62	0.04	1.00																																													
Ba	0.13	0.17	0.20	0.26	1.00																																												
Be	0.06	0.23	0.23	0.29	0.38	1.00																																											
Bi	0.11	0.73	0.00	0.74	0.28	0.32	1.00																																										
Ca	-0.02	-0.02	-0.06	0.14	-0.22	-0.30	-0.07	1.00																																									
Cd	0.13	0.56	0.00	0.33	0.21	0.22	0.46	-0.05	1.00																																								
Ce	-0.04	0.15	0.19	0.03	0.44	0.62	0.18	-0.36	0.10	1.00																																							
Co	-0.06	-0.17	0.40	-0.18	0.02	-0.38	-0.15	0.03	-0.10	-0.12	1.00																																						
Cr	-0.05	-0.09	0.17	-0.10	-0.14	-0.25	-0.10	0.19	-0.09	-0.24	0.49	1.00																																					
Cs	0.18	0.38	0.15	0.69	0.19	0.21	0.44	0.29	0.14	0.01	-0.02	0.06	1.00																																				
Cu	0.01	0.27	0.21	0.21	0.09	-0.05	0.42	-0.09	0.41	-0.15	0.33	0.20	0.11	1.00																																			
Fe	-0.02	-0.16	0.36	-0.14	0.11	-0.31	-0.16	-0.02	-0.14	0.00	0.86	0.35	-0.05	0.14	1.00																																		
Ga	-0.01	-0.06	0.69	-0.01	0.25	0.10	-0.05	-0.11	-0.11	0.30	0.60	0.16	0.06	0.03	0.68	1.00																																	
Ge	0.00	-0.04	0.19	-0.08	0.11	-0.08	-0.12	-0.08	-0.08	0.11	0.56	0.27	-0.05	0.06	0.64	0.42	1.00																																
Hf	-0.05	-0.19	0.29	-0.15	0.16	0.42	-0.26	-0.07	-0.25	0.41	-0.04	-0.01	0.00	-0.36	0.09	0.34	0.15	1.00																															
In	0.01	0.39	-0.07	0.20	0.02	0.03	0.53	-0.18	0.37	0.11	0.10	0.01	0.05	0.52	0.05	-0.11	0.01	-0.32	1.00																														
K	0.19	0.37	-0.25	0.19	0.31	0.45	0.30	-0.26	0.30	0.25	-0.56	-0.27	0.05	-0.10	-0.51	-0.31	-0.21	0.08	-0.01	1.00																													
La	-0.03	0.17	0.20	0.07	0.32	0.66	0.21	-0.25	0.14	0.83	-0.21	-0.18	0.11	-0.13	-0.10	0.15	0.08	0.50	0.11	0.25	1.00																												
Li	0.10	0.20	0.22	0.47	0.08	0.20	0.16	0.19	0.01	0.00	0.02	0.09	0.62	-0.06	-0.01	0.12	0.04	0.30	-0.10	-0.01	0.08	1.00																											
Mg	-0.09	-0.14	0.10	-0.24	-0.40	-0.44	-0.18	0.32	-0.07	-0.57	0.34	0.45	-0.10	0.29	0.14	-0.08	0.17	-0.15	-0.02	-0.25	-0.40	-0.10	1.00																										
Mn	0.04	0.07	0.39	0.03	0.32	0.01	0.07	-0.06	0.27	0.23	0.51	0.09	0.04	0.31	0.51	0.45	0.29	-0.06	0.18	-0.23	0.12	-0.07	-0.07	1.00																									
Mo	-0.02	0.07	-0.32	0.09	0.00	0.01	0.21	-0.03	0.06	0.09	-0.22	-0.12	0.04	0.02	-0.26	-0.33	-0.28	-0.20	0.31	0.15	0.11	0.02	-0.22	-0.16	1.00																								
Na	0.01	0.05	-0.24	-0.04	-0.32	-0.16	-0.03	0.09	0.07	-0.43	-0.22	0.07	-0.14	0.09	-0.30	-0.40	-0.10	-0.31	-0.01	0.04	-0.36	-0.22	0.47	-0.22	-0.13	1.00																							
Nb	-0.01	0.10	0.14	0.14	0.07	0.20	0.11	0.18	0.01	0.13	-0.04	0.08	0.24	-0.02	-0.08	0.12	-0.08	0.26	-0.03	0.07	0.18	0.18	0.04	0.00	0.19	-0.05	1.00																						
Ni	-0.07	-0.10	0.27	-0.12	-0.21	-0.34	-0.09	0.20	-0.04	-0.38	0.64	0.77	0.10	0.41	0.36	0.15	0.27	-0.12	0.08	-0.36	-0.30	0.10	0.66	0.14	-0.16	0.14	0.09	1.00																					
P	0.08	0.11	0.33	0.09	-0.06	-0.20	0.02	0.29	0.17	-0.23	0.21	0.05	0.07	0.17	0.17	0.19	0.05	-0.22	0.01	-0.17	-0.18	-0.01	0.27	0.30	-0.11	0.08	0.11	0.12	1.00																				
Pb	0.11	0.61	0.00	0.49	0.26	0.29	0.64	-0.05	0.51	0.20	-0.12	-0.09	0.28	0.22	-0.12	-0.01	-0.05	-0.15	0.29	0.28	0.21	0.10	-0.16	0.13	0.01	-0.09	0.09	-0.10	0.04	1.00																			
Rb	0.24	0.59	-0.01	0.69	0.43	0.53	0.73	-0.16	0.38	0.25	-0.34	-0.20	0.50	0.16	-0.31	-0.04	-0.20	-0.01	0.15	0.67	0.28	0.27	-0.36	-0.02	0.07	-0.11	0.17	-0.26	-0.05	0.53	1.00																		
Re	-0.01	-0.05	-0.12	0.01	0.02	-0.14	0.06	0.03	0.00	0.00	-0.10	-0.09	-0.05	-0.02	-0.10	-0.05	-0.29	-0.09	0.01	0.00	-0.07	-0.09	-0.19	-0.10	0.29	-0.17	0.02	-0.11	0.08	0.04	0.03	1.00																	
S	0.02	0.49	-0.03	0.37	0.05	0.03	0.45	0.12	0.34	0.07	-0.13	-0.07	0.22	0.14	-0.12	-0.12	-0.07	-0.12	0.27	0.16	0.07	0.27	-0.11	-0.11	0.31	-0.10	0.23	-0.09	0.13	0.34	0.24	0.33	1.00																
Sb	0.10	0.40	0.03	0.60	0.20	0.26	0.51	0.02	0.28	0.01	-0.11	-0.06	0.38	0.19	-0.10	-0.01	-0.05	-0.11	0.16	0.17	0.03	0.22	-0.11	0.07	0.02	0.02	0.12	-0.07	0.02	0.35	0.52	-0.02	0.25	1.00															
Se	-0.01	0.08	0.03	0.04	0.07	0.06	0.10	-0.09	0.10	0.14	-0.01	-0.06	-0.07	0.08	0.03	-0.04	0.29	-0.01	0.10	0.05	0.17	0.04	-0.04	-0.01	0.20	-0.08	0.02	-0.07	0.14	0.07	-0.02	0.37	0.45	-0.02	1.00														
Sn	-0.04	0.15	-0.21	0.06	0.02	0.22	0.28	-0.16	0.10	0.23	-0.26	-0.07	0.01	0.07	-0.31	-0.28	-0.23	0.02	0.45	0.28	0.30	-0.03	-0.12	-0.14	0.58	-0.01	0.46	-0.10	-0.11	0.10	0.19	0.14	0.25	0.04	0.20	1.00													
Sr	-0.04	-0.03	0.13	0.17	-0.08	-0.17	-0.03	0.69	-0.13	-0.22	0.05	0.12	0.38	-0.14	0.05	0.12	-0.06	0.11	-0.20	-0.25	-0.14	0.31	0.21	-0.08	-0.06	0.00	0.20	0.12	0.22	-0.05	-0.07	0.17	0.15	0.05	-0.01	-0.15	1.00												
Ta	0.00	0.12	0.14	0.19	0.07	0.17	0.15	0.21	0.04	0.08	-0.04	0.06	0.32	0.04	-0.11	0.08	-0.11	0.18	-0.03	0.09	0.15	0.21	0.06	0.00	0.13	-0.08	0.89	0.11	0.13	0.10	0.22	0.05	0.27	0.17	0.00	0.38	0.21	1.00											
Te	0.09	0.57	-0.05	0.50	0.15	0.17	0.71	-0.09	0.42	0.16	-0.17	-0.10	0.29	0.32	-0.16	-0.16	-0.11	-0.23	0.55	0.28	0.18	0.12	-0.16	-0.01	0.44	-0.08	0.24	-0.10	0.07	0.45	0.45	0.21	0.71	0.36	0.33	0.41	-0.06	0.28	1.00										
Th	0.04	0.11	0.34	0.34	0.49	0.61	0.32	-0.13	-0.01	0.58	-0.03	-0.04	0.34	-0.05	0.09	0.36	0.10	0.60	-0.03	0.12	0.65	0.32	-0.41	0.11	0.00	-0.47	0.27	-0.15	-0.26	0.20	0.44	0.00	0.05	0.22	0.05	0.14	0.05	0.28	0.15	1.00									
Ti	0.01	-0.16	0.33	-0.12	0.09	-0.24	-0.18	0.05	-0.17	-0.01	0.72	0.33	-0.05	0.00	0.87	0.64	0.55	0.27	-0.12	-0.40	-0.06	0.06	0.16	0.38	-0.29	-0.26	0.12	0.28	0.20	-0.10	-0.24	-0.08	-0.08	-0.10	0.03	-0.24	0.15	0.04	-0.20	0.14	1.00								
Tl	0.21	0.64	0.19	0.76	0.47	0.46	0.73	-0.11	0.38	0.29	-0.09	-0.10	0.58	0.26	-0.08	0.16	-0.02	-0.02	0.19	0.44	0.28	0.38	-0.37	0.19	0.02	-0.24	0.16	-0.12	0.06	0.55	0.88	-0.02	0.30	0.52	0.02	0.09	-0.02	0.22	0.46	0.48	-0.08	1.00							
U	0.07	0.11	0.21	0.37	0.36	0.46	0.20	0.10	0.02	0.42	-0.05	-0.05	0.38	-0.14	0.07	0.27	0.07	0.56	-0.11	0.10	0.49	0.56	-0.40	0.07	0.04	-0.46	0.20	-0.17	-0.21	0.17	0.37	0.00	0.13	0.19	0.03	0.02	0.18	0.21	0.07	0.78	0.16	0.44	1.00						
V	-0.02	-0.17	0.27	-0.15	0.04	-0.37	-0.16	0.02	-0.15	-0.10	0.87	0.42	-0.06	0.18	0.95	0.57	0.62	0.07	0.04	-0.50	-0.17	-0.04	0.26	0.42	-0.26	-0.20	-0.03	0.45	0.11	-0.13	-0.31	-0.10	-0.13	-0.11	0.01	-0.27	0.05	-0.06	-0.17	0.05	0.88	-0.11	0.03	1.00					
W	0.12	0.60	0.08	0.59	0.23	0.24	0.60	0.04	0.41	0.01	-0.14	-0.05	0.44	0.32	-0.13	0.00	-0.10	-0.10	0.16	0.23	0.05	0.31	-0.12	0.00	0.07	-0.02	0.28	-0.05	0.07	0.45	0.60	0.01	0.45	0.44	0.03	0.14	0.07	0.33	0.46	0.25	-0.09	0.65	0.19	-0.11	1.00				
Y	-0.06	-0.11	0.33	-0.21	0.16	0.48	-0.21	-0.16	-0.06	0.53	-0.10	-0.12	-0.14	-0.29	0.00	0.35	0.10	0.76	-0.22	0.15	0.57	0.12	-0.19	0.04	-0.21	-0.27	0.07	-0.20	-0.08	-0.04	0.00	-0.08	-0.10	-0.15	0.04	-0.02	0.01	0.01	-0.19	0.38	0.14	-0.01	0.38	-0.07	-0.15	1.00			
Zn	0.11	0.47	0.09	0.29	0.27	0.12	0.42	-0.07	0.88	0.05	0.08	-0.03	0.11	0.51	0.11	0.06	0.08	-0.24	0.36	0.14	0.08	-0.02	-0.04	0.42	-0.06	0.01	-0.07	0.01	0.20	0.48	0.30	-0.04	0.24	0.27	0.09	-0.03	-0.14	-0.05	0.31	0.01	0.05	0.35	0.03	0.09	0.44	-0.08	1.00		
Zr	-0.07	-0.21	0.26	-0.19	0.15	0.38	-0.27	-0.13	-0.27	0.42	-0.04	-0.03	-0.05	-0.37	0.11	0.37	0.17	0.94	-0.32	0.10	0.42	0.23	-0.15	-0.08	-0.22	-0.26	0.20	-0.15	-0.28	-0.17	-0.04	-0.11	-0.13	-0.13	0.00	-0.02	0.09	0.11	-0.25	0.52	0.27	-0.06	0.49	0.09	-0.13	0.73	-0.24	1.00	
Hg	0.17	0.43	0.11	0.62	0.25	0.29	0.59	-0.01	0.28	0.06	-0.05	-0.06	0.40	0.25	-0.01	0.11	0.00	-0.08	0.15	0.17	0.10	0.23	-0.14	0.10	-0.03	-0.03	0.09	-0.08	0.07	0.39	0.59	-0.04	0.21	0.72	0.01	0.03	0.04	0.11	0.31	0.33	0.00	0.60	0.27	-0.02	0.52	-0.12	0.30	-0.12	1.00

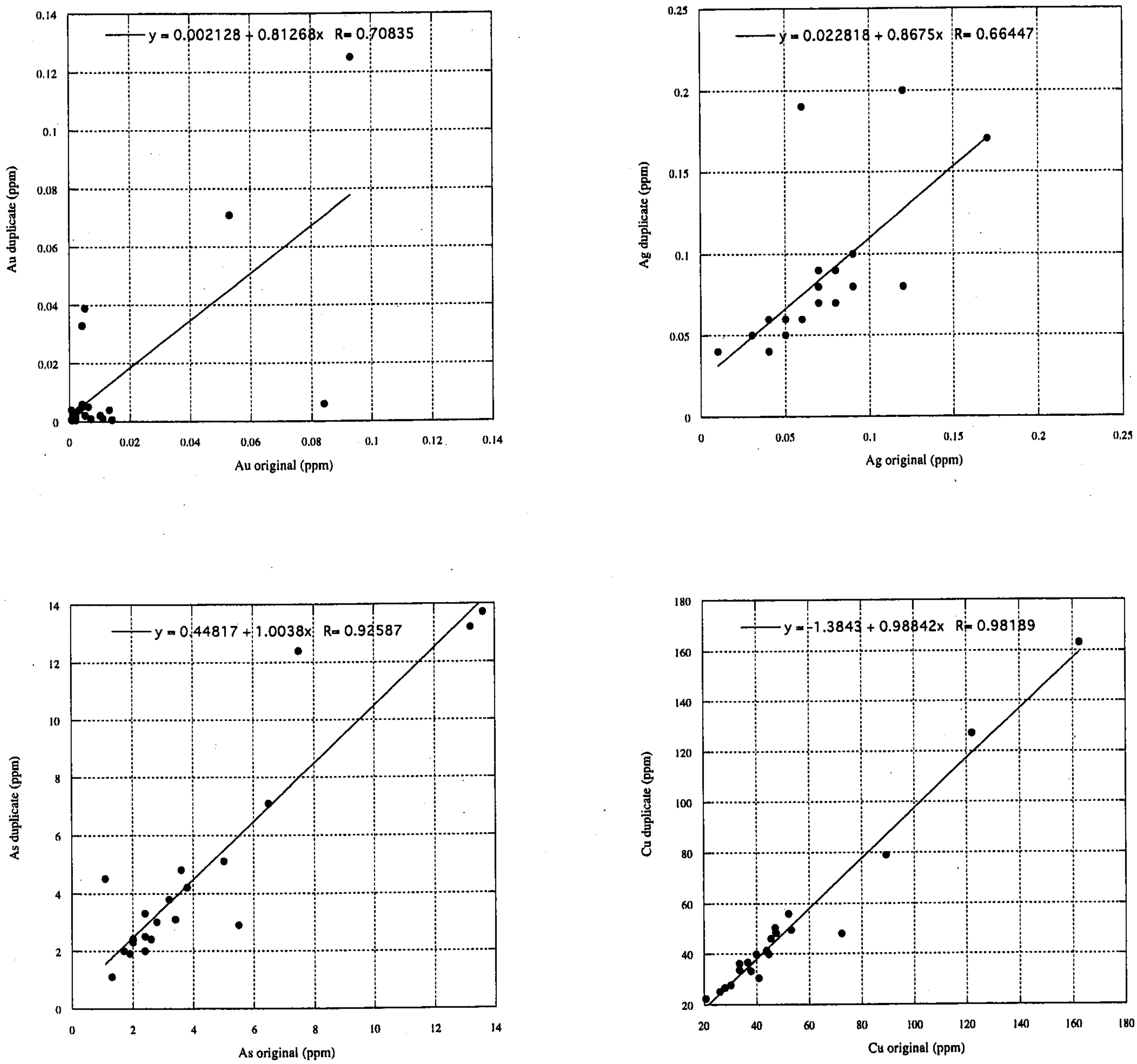
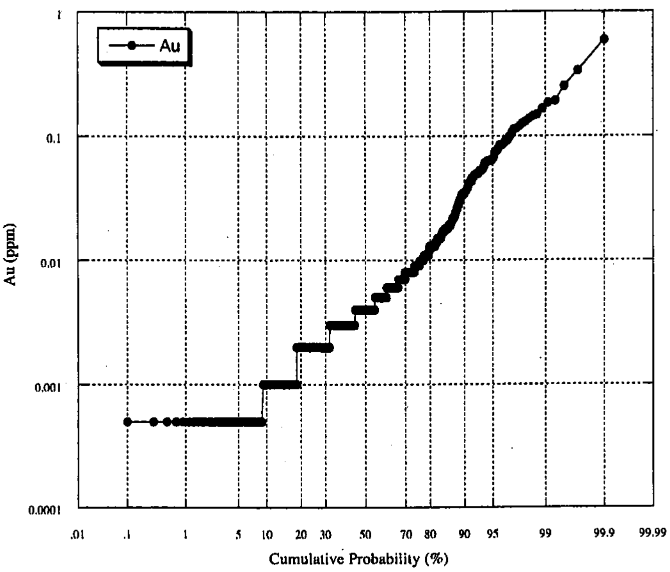
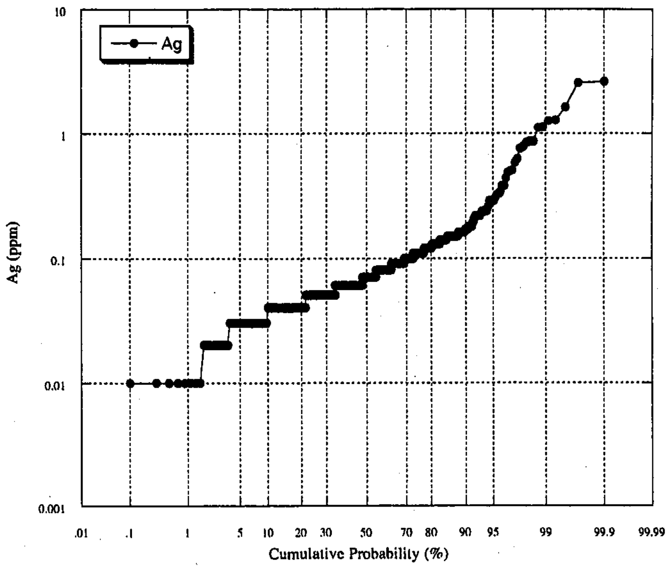
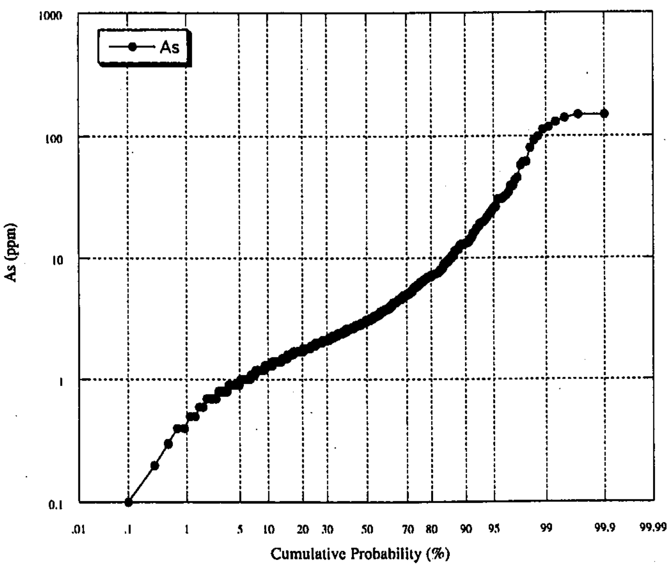


Fig. 4-2 Correlation between Elements of Geochemical Samples







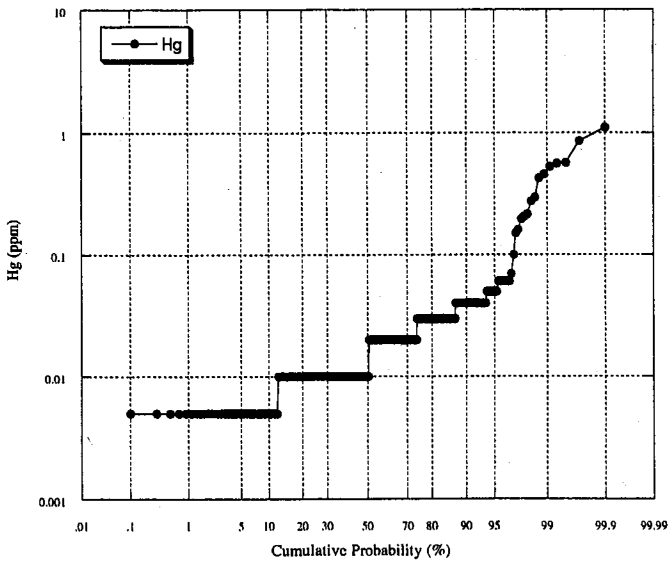


Fig. 4-3 Probability Graphs of Stream Sediment Samples (Au, Ag, As and Hg)

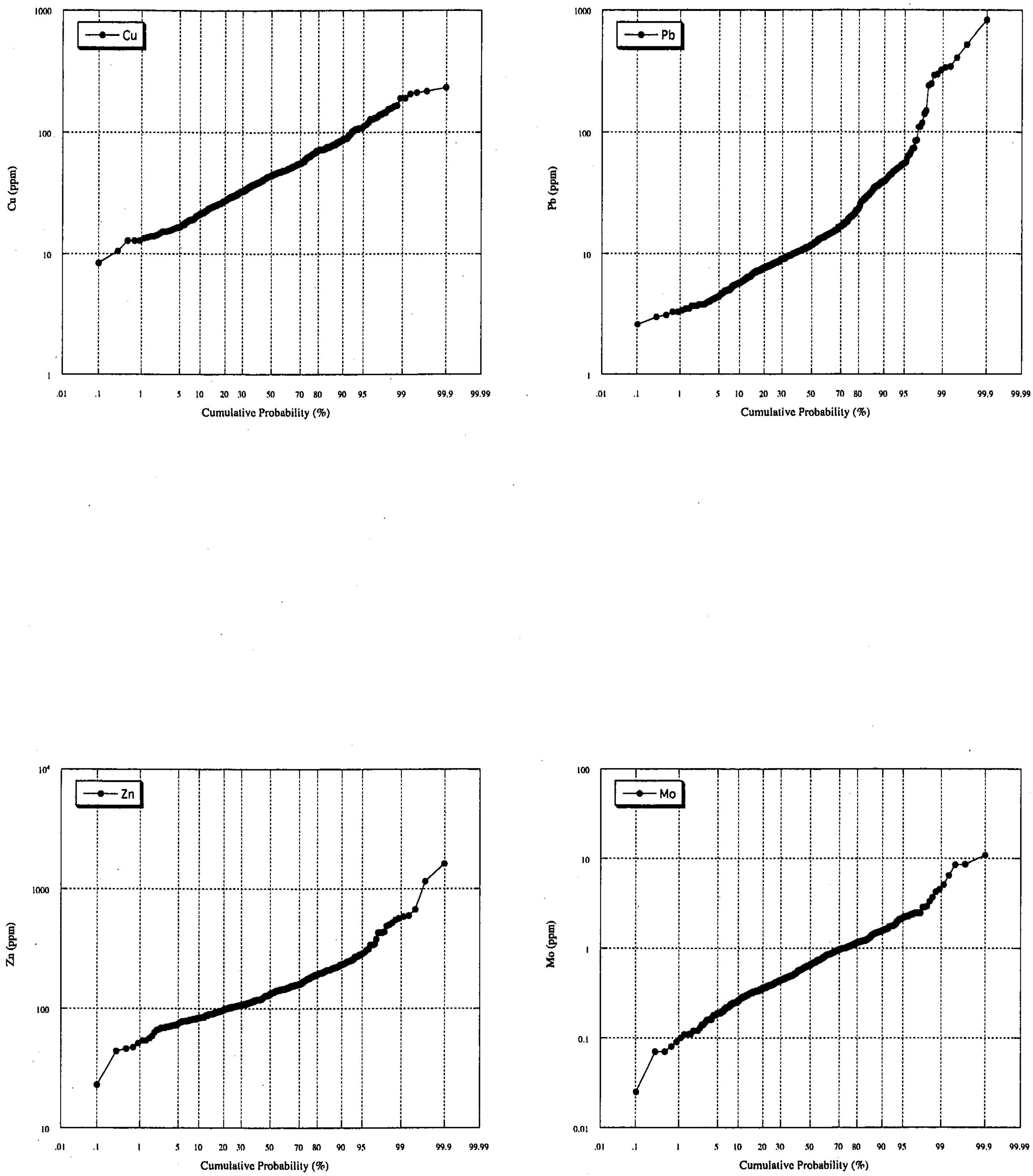


Fig. 4-3 Probability Graphs of Stream Sediment Samples (Cu, Pb, Zn and Mo)

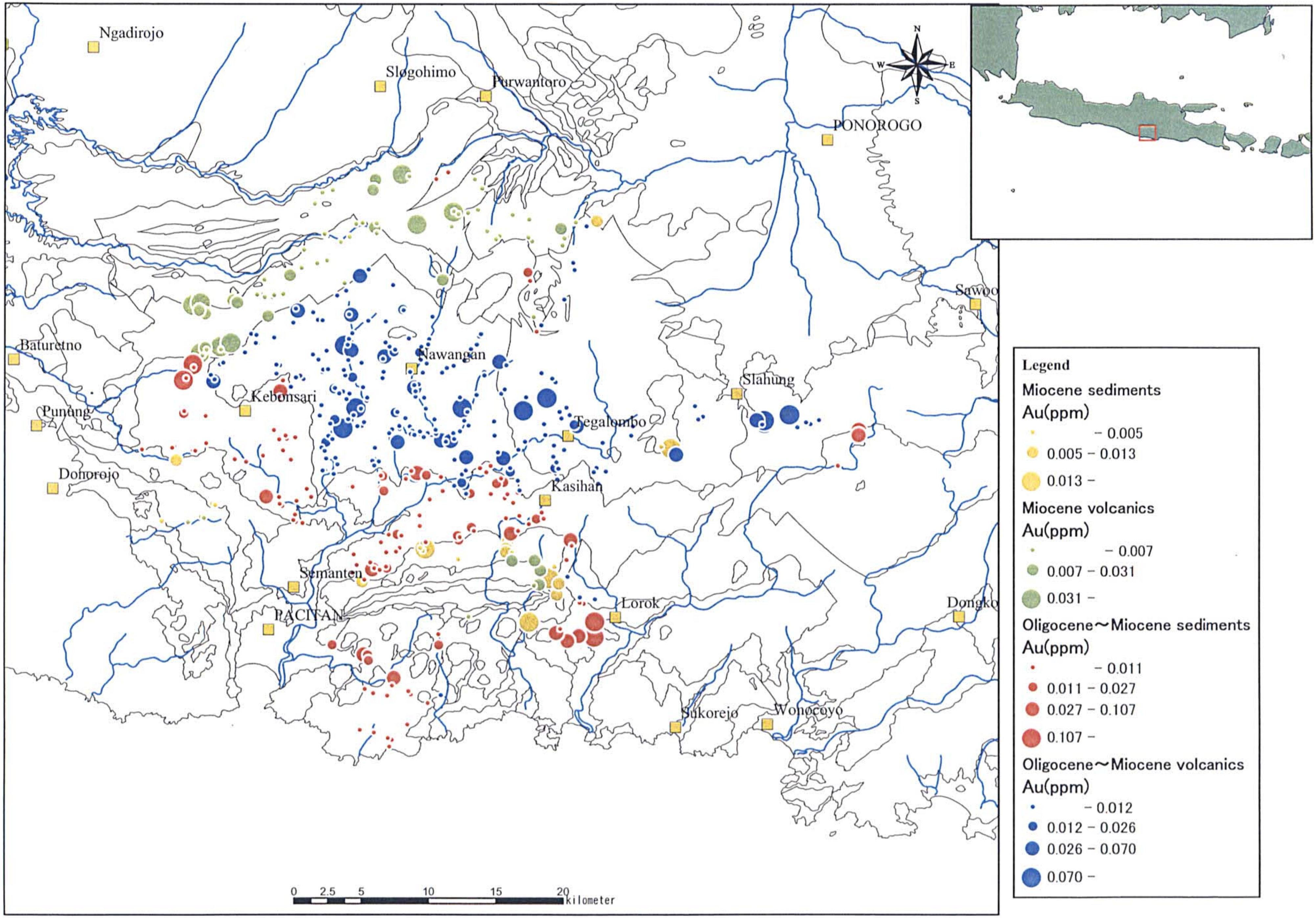


Fig. 4-4 Geochemical Anomaly Distribution of the Element Au

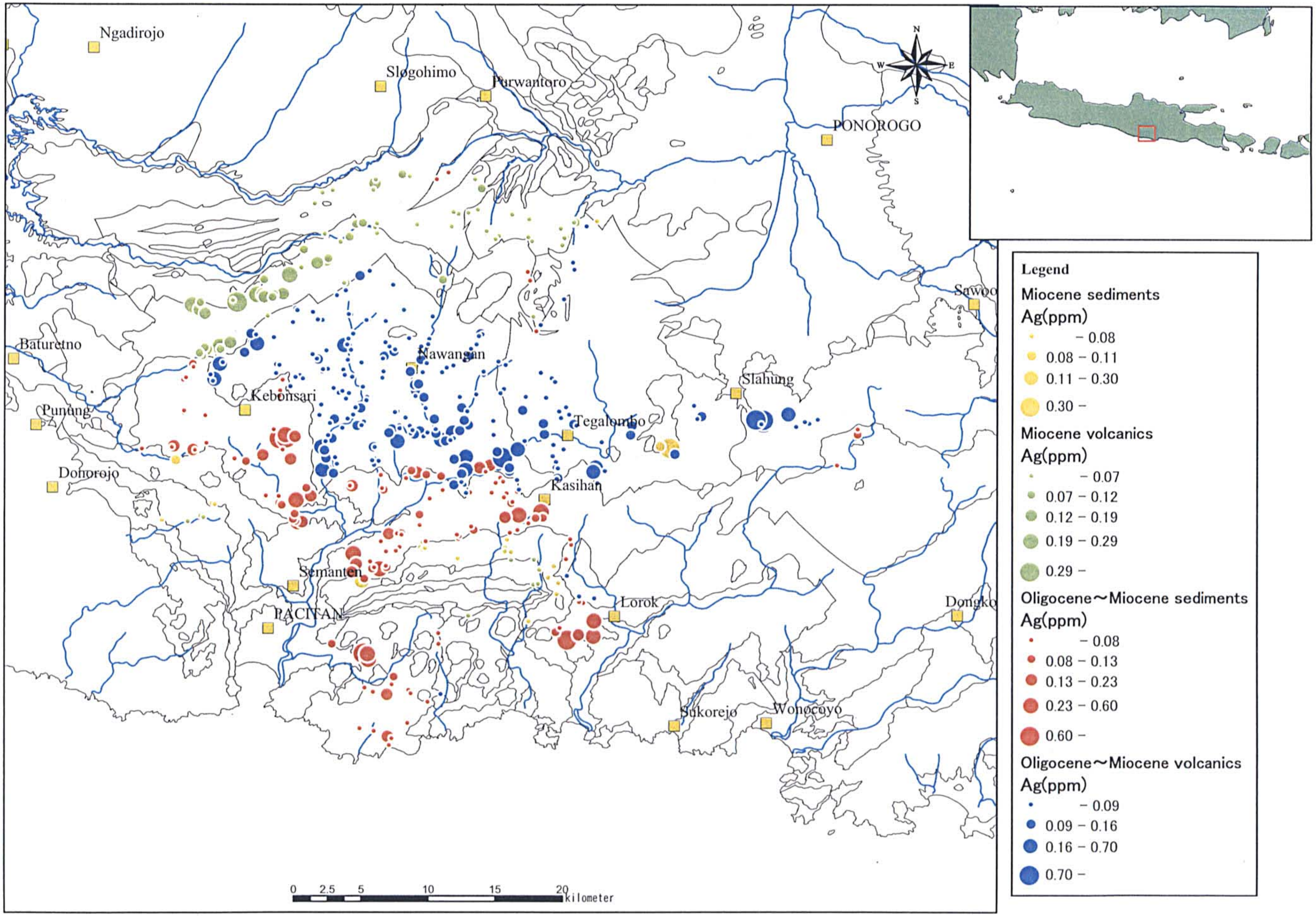


Fig. 4-5 Geochemical Anomaly Distribution of the Element Ag

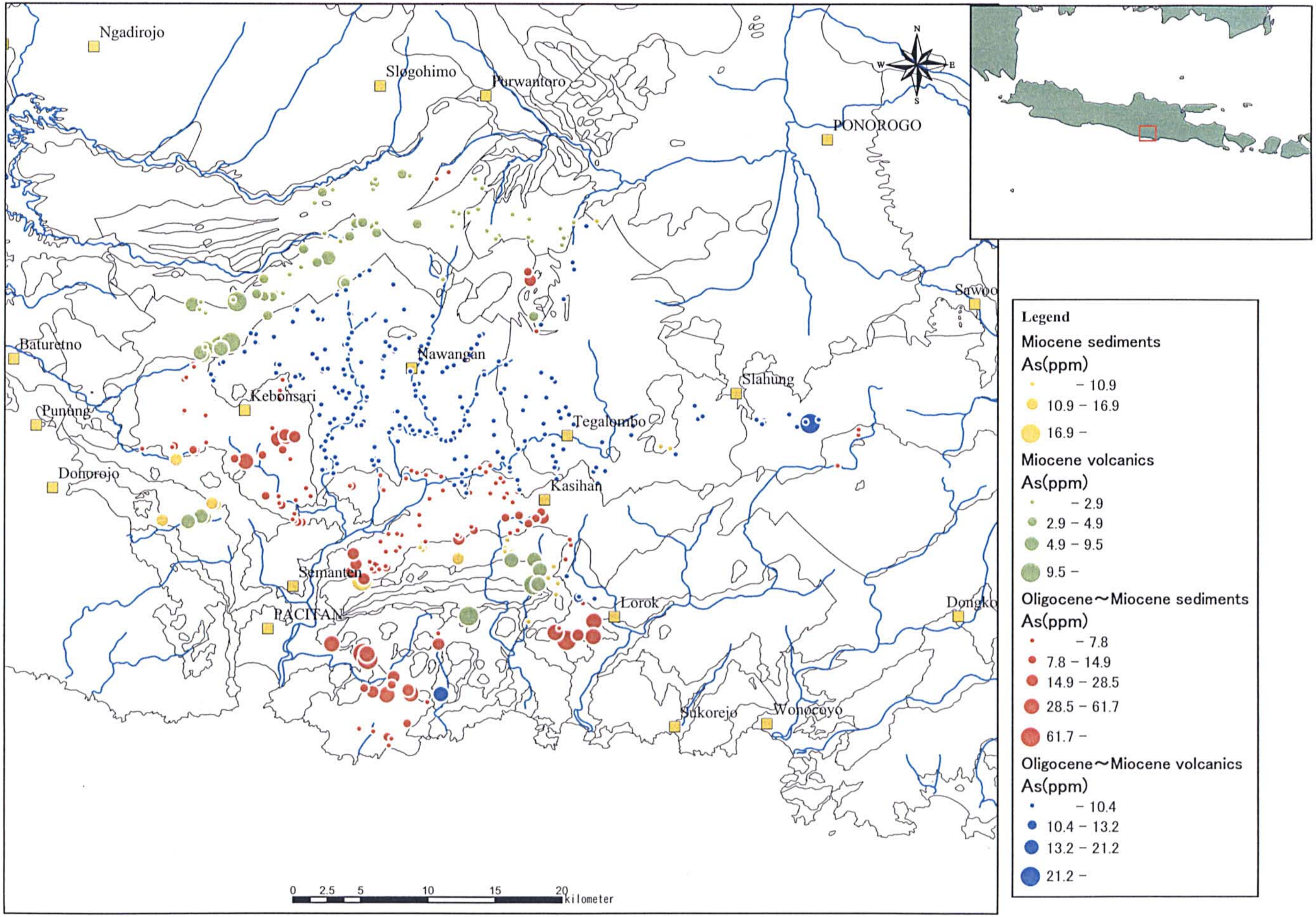


Fig. 4-6 Geochemical Anomaly of Distribution of the Element As

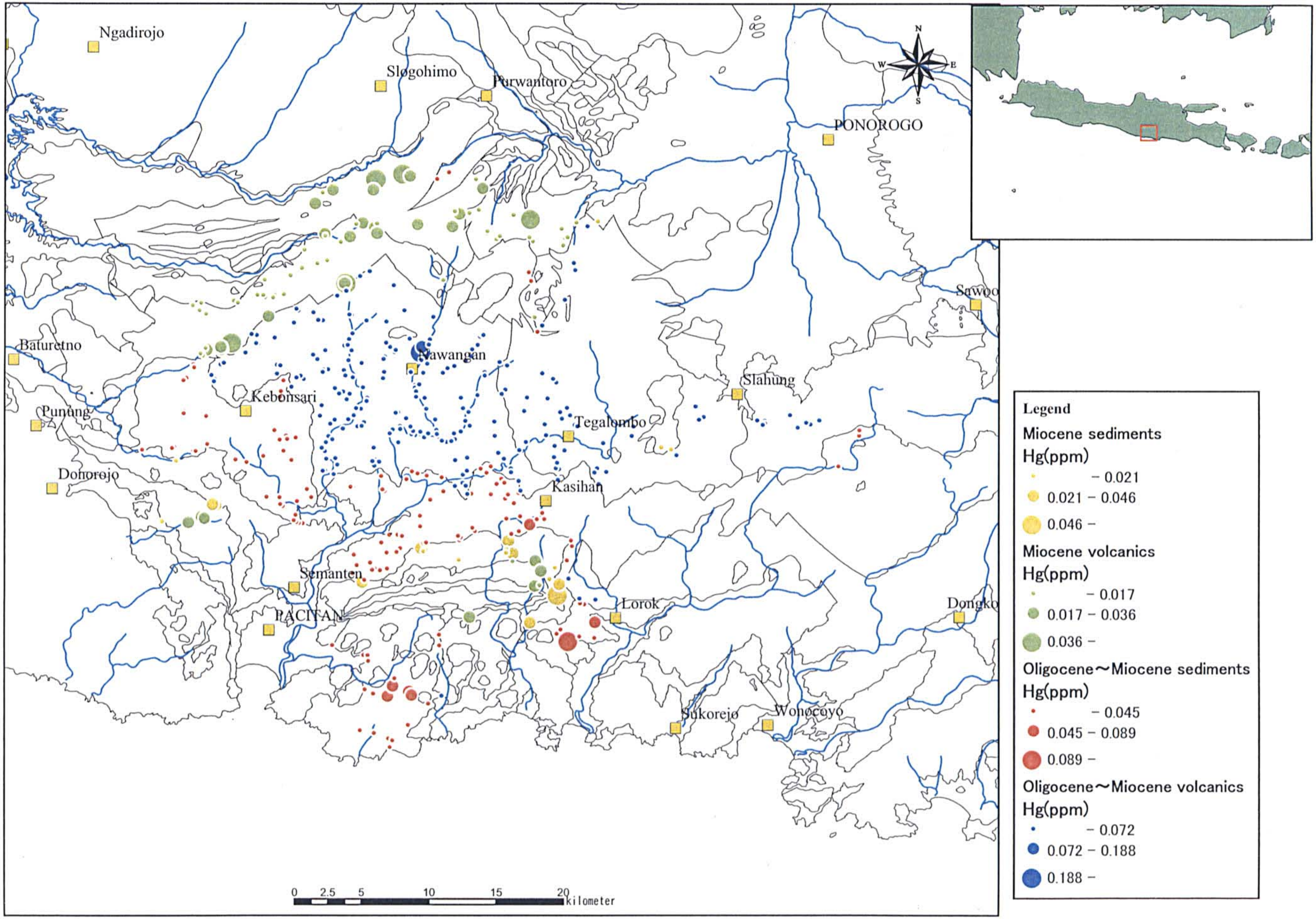


Fig. 4-7 Geochemical Anomaly Distribution of the Element Hg

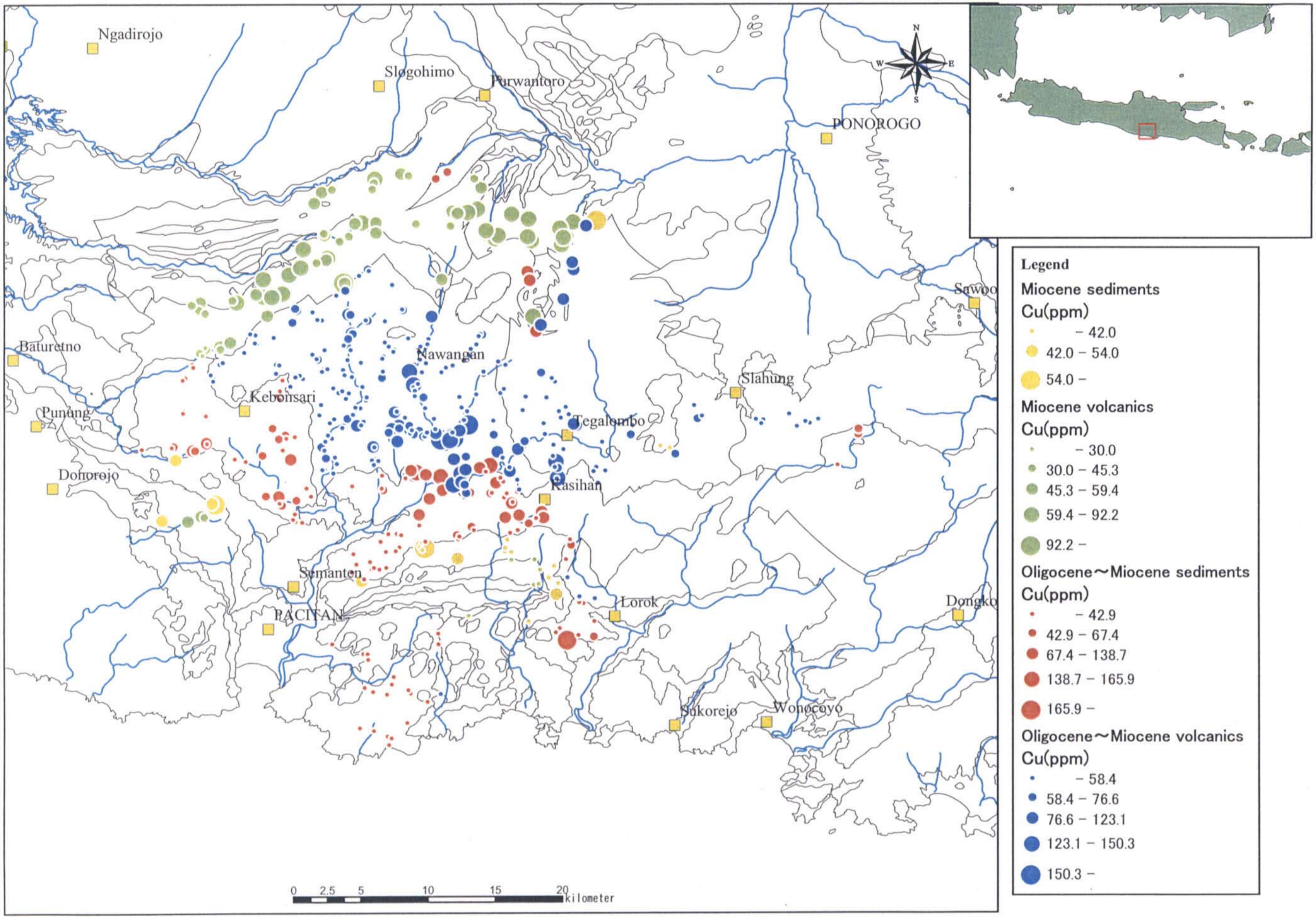


Fig. 4-8 Geochemical Anomaly Distribution of the Element Cu

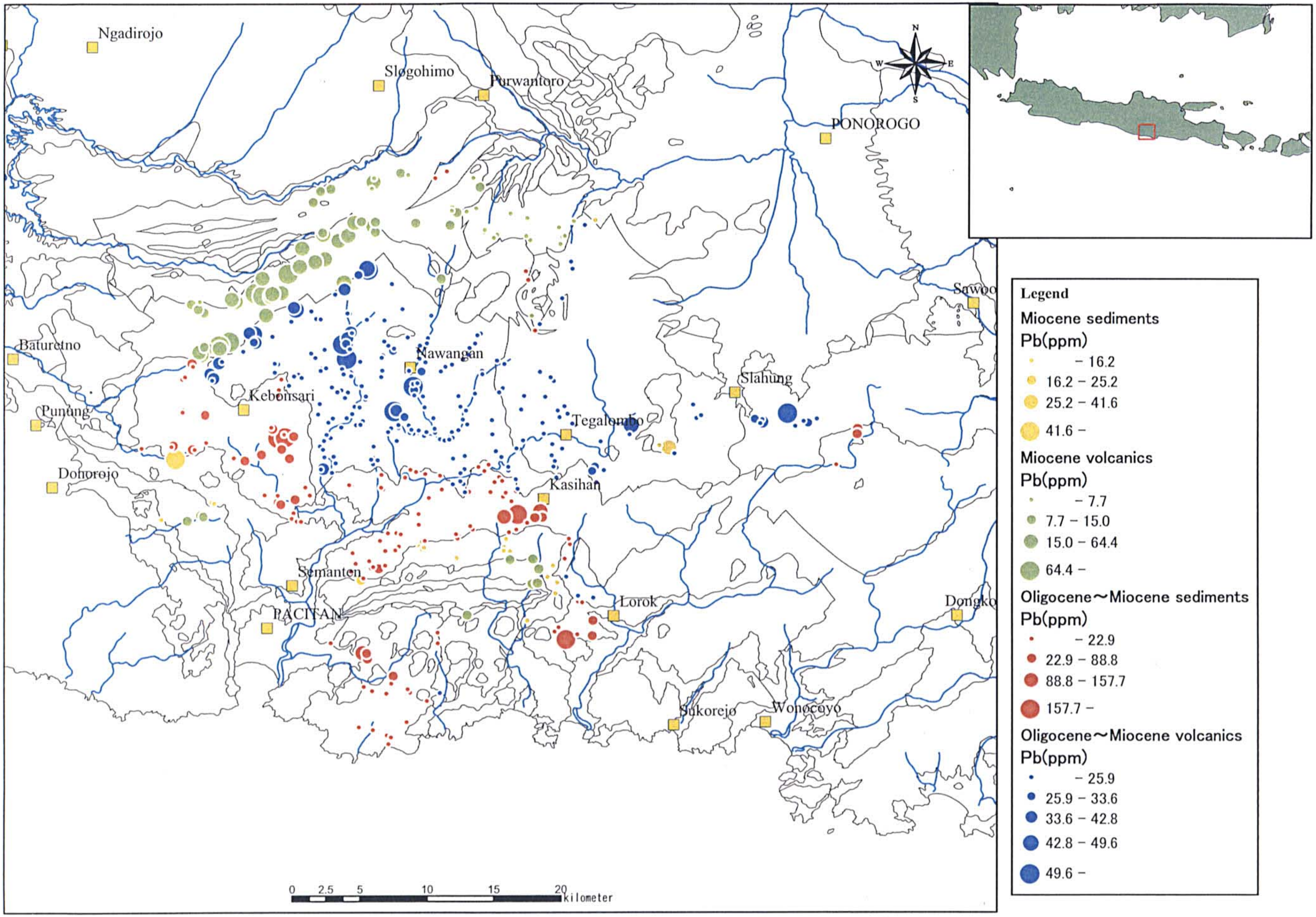


Fig. 4-9 Geochemical Anomaly Distribution of the Element Pb

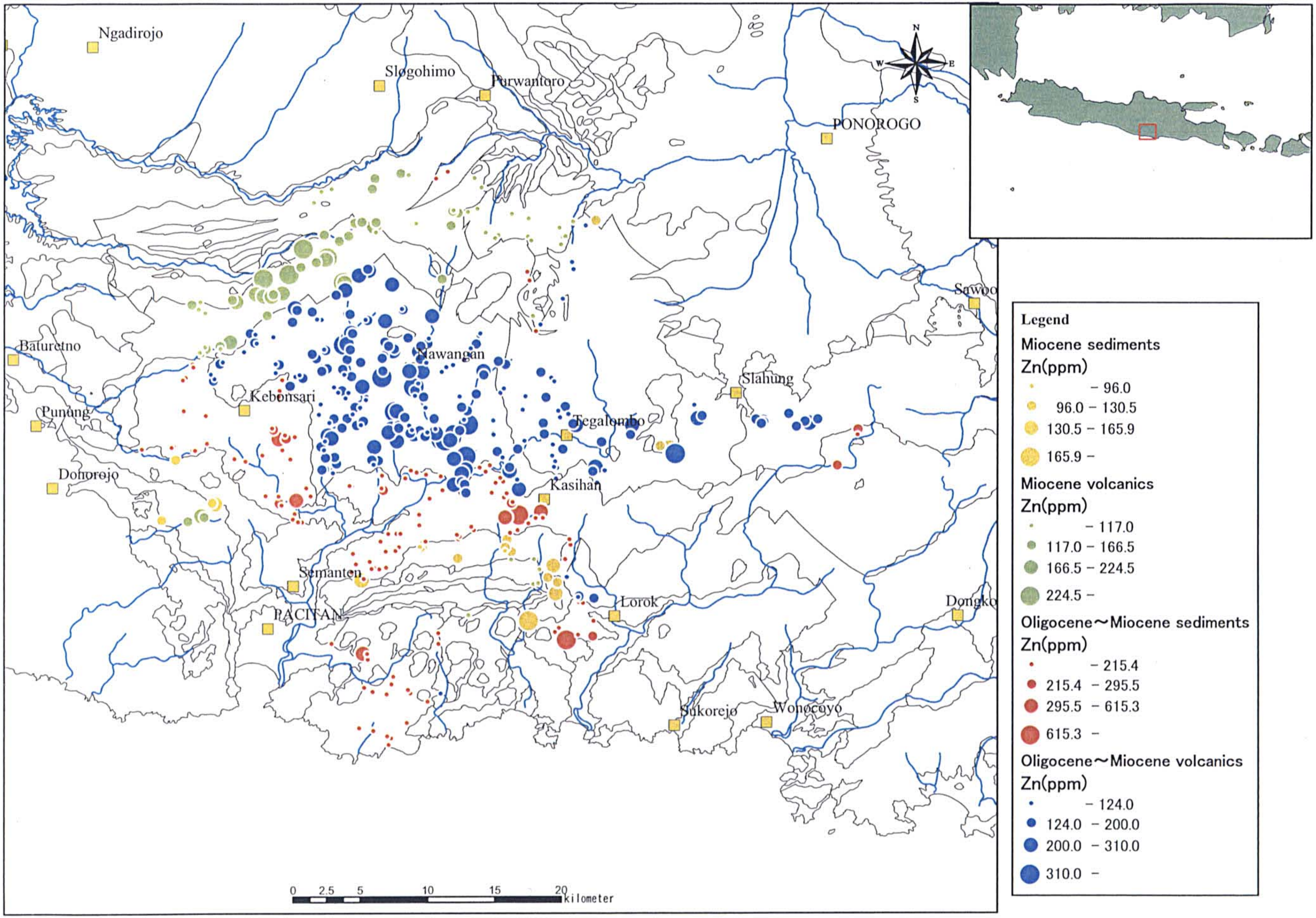


Fig. 4-10 Geochemical Anomaly Distribution of the Element Zn

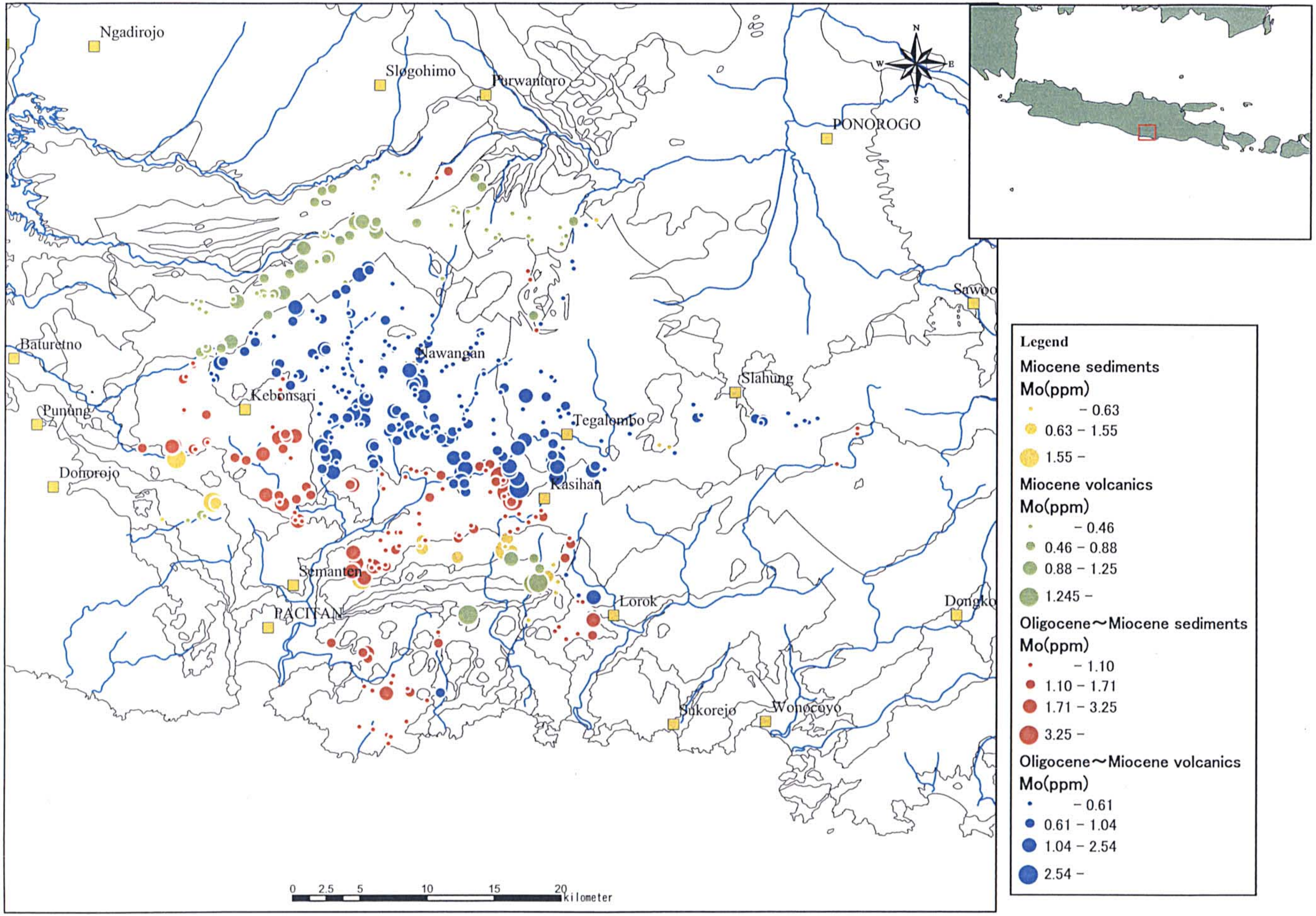


Fig. 4-11 Geochemical Anomaly Distribution of the Element Mo

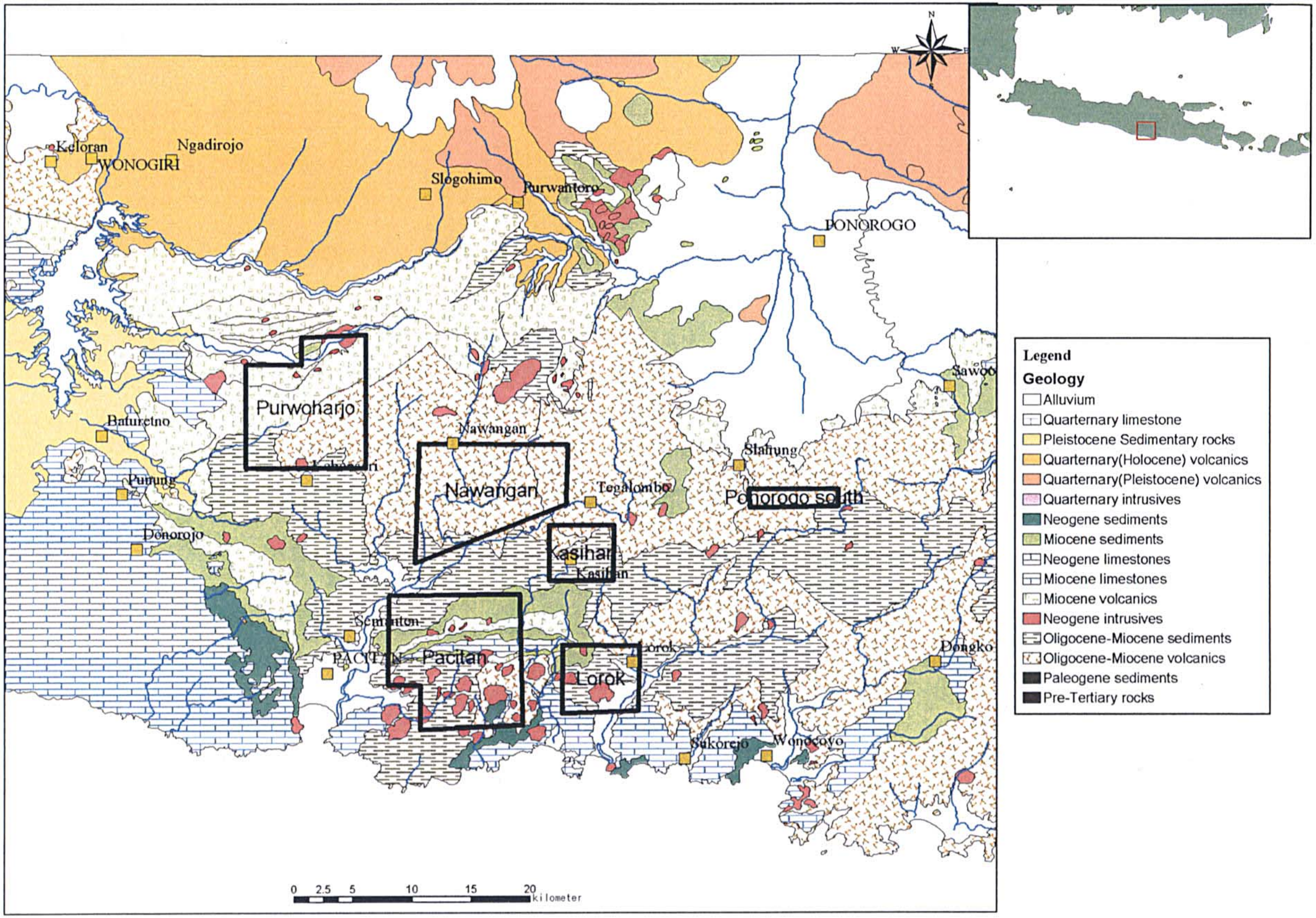


Fig. 4-12 Mineralized zones of the Semi-detailed Survey Area

Chapter 4   Geological Survey

Chapter 4 Geological Survey

4-1 Method of Survey

Geological Survey was conducted in the Ponorogo South district and Prambon district, which cover area extents of $10km^2$ and $60km^2$, respectively., totalling$70km^2$. Topographic maps at a scale of 1:10, 000 were used for base maps. Routes for traversing were selected based on the phase 1 survey and phase 2 geochemical survey results. GPS was used for location confirmation during traversing. The survey results are compiled on geological maps at a scale of 1: 10, 000 in reference of existing data and maps. Rock samples were taken to be the various laboratory tests; 50 samples for observation of the thin sections, 50 samples for observation of the polished sections, 100 samples for X-ray diffraction analysis, 250 samples for chemical analysis, 5 samples for homogenization temperatures and salinities measurement of fluid inclusions in quartz and 10 samples for whole rock analysis.

The Ponorogo South district is divided into two sub-districts: Cepoko and Nepo. The Cepoko sub-district is 8 km in east –west, and 2 km in north-south to the south of the district. The Nepo sub-district covers 2 km in east-west, and 3.5 km in north-south.

4-2 Ponorogo South District

Both Ponorogo South and Prambon districts are underlain mainly by Oligocene to Miocene volcanic rocks and volcaniclastic rocks. Limestone of Oligocene-Miocene-Pliocene are exposed in both districts. Intrusive rocks of basalt, andesite and dacite-quartz porphyry and diorite-quartz diorite intruded in to the volcanic rocks and volcaniclastic rocks

4-2-1 Geology

(1) Stratigraphy

The Ponorogo South sub-district is underlain by andesitic and dacitic-rhyolitic and basaltic volcanic and volcaniclastic rocks, in ascending order. The Cepoko sub-district is underlain by basaltic-andesitic volcanic and volcaniclastic rocks. The existing map of Pacitan quadrangle correlate those volcanic and volcaniclastic rocks to Oligocene-Lower Miocene Mandalika Formation (Tomm, Tommt), Arjosari Formation (Toma) and Watupatok Formation (Tomw), and limestone to Wonosari Formation (Tmwl). However, The volcanic and volcaniclastic rocks in the Cepoko sub-district was termed as Mandalika Formation as it was difficult to define the boundary and the successions of the volcanic and volcaniclastic rocks of Mandalika Formation and Arjosari Formation in the sub-district. On the other hand, The basaltic rocks in the Nepo sub-district are correlated to Watupatok Formation following the existing map.

(a) Mandalika Formation (Tomma, Tommd, Tommb)

Distribution: Distributed widely in the Cepoko-sub-district.

Composition: Composed of andesitic(Tomma), dacitic-rhyolitic(Tommd) and basaltic(Tommb) lava and volcaniclastic rocks. Among those, andesitic rocks are most widely exposed. Generally massive volcaniclastic rocks without bedding are abundant and stratigraphy and structure is difficult to clarify, but fine-grained volcaniclastics are intercalated in some parts.

Structure: Strike E-W to N-S in the northeastern part, and ENE-WSW trending gentle anticline and syncline occur repeatedly southward from the north..

Stratigraphy and correlation: This formation is correlated to Mandalika Formation of the Pacitan and Ponorogo Quadrangle sheets, but includes Arjosari Formation., (Toma) of the Pacitan sheet. The Arjosari F., is defined as consisting mainly of conglomerate, sandstone, and siltstone with intercalation of volcaniclastic rocks and lava. But in the survey area, volcaniclastic rocks and lava are possibly dominant, and is difficult to distinguish from Mandalika Formation. Thus the two nits were unified to Tomm.

Thickness: More than 500m.

(b)Watupatok Formation (Tomw, Tomwt)

Distribution: Distributed in the Nepo sub-district.

Composition: This is composed of basalt-andesite similar to Mandalika Formation., and the unit mainly composed of basalt was separated as Watupatok Formation. This formation is bedded with intercalation of green tuff and tuffaceous sandstone, but is generally non-bedded and massive.

Structure: This is harmonious with Mandalika Formation outside the sub-district, but it is not obvious in the sub-district.

Stratigraphy and correlation: This formation interfingers with Mandalika Formation. The K-Ar age of the rock shows 38.7 Ma based on the phase 1 survey.

Thickness: More than 500m.

(c) Campurdarat Formation

Distribution: Distributed narrowly in eastern part of the Cepoko sub-district.

Composition: This is composed of white-gray limestone, and is generally non-bedded and massive. The rocks may be intercalated with andesitic lava of Mandalika Formation.

Structure: This appears to be harmonious with Mandalika Formation, but it is not obvious in the sub-district.

Stratigraphy and correlation: This formation may interfinger with Mandalika Formation. Thickness: Less than 100m in the sub-district.

(d) Intrusive rocks

Diorite-quartz diorite, basalt and dacite are exposed in the sub-district.

(2) Geologic Structure

The dominant geologic structure of the Cepoko and the Nepo sub-districts trends in the NE-SW and NE-SW direction, respectively. Regarding fold structures, No folding is obvious, but inferred to occur. gentle anticline and syncline based on the strikes of Mandalika Formation.

The intrusive rocks largely has N-S to NNE-SSW strike with dips higher than 70°.

(3) Alteration

The alteration minerals were identified in the field. A total of 30 samples was collected from the Ponorogo South for accurate identification by X-ray diffractometry in the laboratory.

Identified alteration minerals are shown in Table 5-3. Of these the following minerals are considered to be related to mineralization. Sericite, mixed-layer clay minerals (smectite/sericite and smectite/chlorite), smectite and kaolin minerals.

- Sericite: Sericite is often found in zones adjacent to mineralization.
- Mixed-layer clay minerals (smectite/sericite, smectite/chlorite): These minerals occur in zones overlapping or adjoining the distribution of sericite.
- Smectite: Smectite occurs with mixed-layer minerals, but the distribution area is narrow.
- Kaolin mineral: These minerals were detected in rather small amount.

(4) Mineralization

In Prambon district, three major zones had been set up as main targets of the geological survey. The first is the alteration area around the Cepoko village. The second area is the gold geochemical anomaly detected during the detailed geochemical survey near Mt. Laring. The third is the Nepo river along where a quartz vein of width 1.8 m crops out in the basaltic rocks. The first and the second areas are termed as Cepoko sub-district within the Ponorogo South district. The third area is termed as Nepo River sub-district.

A prominent copper mineralization zone was identified in the Nepo sub-district. The two outcrops in the Salak River and the upstream of the main Nepo River appear to be in one mineralized zone. The mineralization occurs as quartz vein or silicified vein with chalcopyrite and minor amount of galena. The width of the vein is 1.1 to 1.5 m and the total length the veining zone is expected to continue about 2 km between the two outcrops. The northern extension of the zone is not clear due to lack of poor exposure of bed rocks and may be cut by the above mentioned NE-SW trending faults. The strike and dip of the vein fluctuate between N15^{o}E to N15^{o} W and 30^{o}W to 65^{o} W, respectively. The main ore mineral is chalcopyrite with minor amount of sphalerite and galena, and pyrite. Copper oxides (mainly malachite) occur at the outcrop in the Salak River. The mode of occurrence of the veins are different from the quartz veins at the main stream of the Nepo River in that they contain significant amount of sulfides minerals and they appear to continue long along strike direction. Main alteration mode is silicification within wide propylitic envelopes, while argillic alteration occurs in places in the sub-district. Relation between the quartz veining and occurrence of dioritic rocks accompanying argillic alteration is to be investigated.

The NE-SW trending faults in the Nepo sub-district appear to control the displacement of the quartz veins accompanying Au, Ag, Cu, Pb and Zn mineralization. The temporal relation between mineralization and faulting (or the displacement) is yet to be revealed by detailed investigation of displacement of veins, while they are active in the same period.

(5) Mineral Potential of the Survey Area

The geochemical anomaly near the Mount Laring in the Cepoko sub-district is, Ponorogo South are concluded to be related with silicified veins in argillic alteration zone of the dacite-rhyolite rocks. The quartz veins and silicified veins in the eastern part of the Cepoko sub-district rerun anomalous gold values. The veins appers to be of epithermal and the mineralization is expected to continue further to the depth. On the other hands, no significant mineralization was found on the upstream of the Au geochemical anomalies to the west of Nepo river. However, the quartz vein cropping out in the Salak river is expected to continue 1-2 km to south where similar looking quartz-silicified vein crops out at in the upstream of the Nepo river. There is a veinlets at the footwall side or the main vein above mentioned. It is also suspected that the quartz veins in the Nepo river are also related to the main vein in the Salak river, if the fault running along the Nepo River displace the vein downward at the west. The gold values of the main vein are not high, while a quartz vein of 15 cm width returned 0.3 g/t Au, while copper value of the vein is 1.48%Cu. Copper values of the main veins are low and should be investigated.

4-2-2 Soil Geochemical Survey

(1) Selection of the Soil Geochemical Survey Area

During the course of traversing, Quartz veins with chalcopyrite, sphalerite and/or galena were found in the Ponorogo South and Prambon district. In Ponorogo South district a quartz vein zone was expected to continue to south more than 1 km.. In Prambon, sphalerite and/or galena quartz veins were found within wide alteration zones with pyrite dissemination. To the north of the zone a lot of quartz or silicified veins with pyrite dissemination occur. Those features were thought to be related to a series of hydrothermal events in wide areas. Therefore, both districts were considered to be worthwhile of follow-up survey. During the geological survey, the Ponorogo South district is selected as soil the geochemical survey area because the two outcrops of quartz veins at the Salak river and the upstream of the Nepo river continue and vein widths are wide. However, the exposures between the two outcrops are not well. Therefore, Soil geochemical survey was expected to be applied to estimate the location of the buried vein, then useful for planning the drilling. On the other hand, in Prambon, it was considered to take a long time to cover the area from the Beloran river to the Sumurup river. Consequently, the area covering the upstream of the Nepo river to the Salak river was selected for the soil geochemical survey.

(2) Survey Method

A total of 200 sites were selected for soil geochemical sampling in the area covering 2, 000km^2, 700m X 2,240m. The samples were taken basically on 14 lines at 160 m spacings. On each line, 13 samples were taken in intervals of about 50 m, but 100 m at both ends of the lines. The soil samples of B horizon were taken generally at 30-40 cm below the ground surface. The samples were reduced in amount to 250 g and dried by natural conditioned. The elements shown in Table 1-2 were analyzed in ALS Chemex in Canada. The samples are crushed to a size of -75 μm (85%). Gold was assayed by gravimetric method, Hg by Cold Vapor ICP method, and other elements by ICP method.

(3) Results

(a) Results of Chemical Analysis

The results of the chemical analysis of soil samples are listed on Table C-3. The basic statistics of the data are shown on Table 5-6.

(b) Correlation of the elements

The correlation coefficients between elements are shown on Table 5-7.

・Au： As seen in Table 5-', Au has weak positive correlation with As(arsenic), but does not show notable correlation with Hg, Pb, Zn, Cu.

・Ag： Ag has positive correlation with As, Mo and Pb.

・Cu： Cu has positive correlation with Pb, Cd, Mn, Mo, Pb and Zn.

・Pb： Pb has positive correlation with Ag, Cd, Cu and Zn.

・Zn：Zn has positive correlation with Cd, Cu, Mn, Mo and Pb.

・Mo： Mo has positive correlation with Ag, Cd, Cu, P and Te.

(4) Consideration of the sampling conditions

The sampling area is mostly underlain by basaltic-andesitic rocks of Mandalika Formation. The almost all the soil samples are taken from B-horizon. There were neither quartz vein materials and strongly altered rock chips in any samples, while there were floats of quartz vein or altered rocks near two sampling sites.

(5) Distribution of Values of Precious and Base Metal Elements

The Au, Ag, Cu and Pb -Zn mineralization has been expected based on the geological survey. It appears, based on the soil geochemical survey, that high values of Au, Cu, Pb and Zn are concentrated on the outcrop areas along the Salak River and the upstream of the Nepo River. However, the background value of Au appears to be rather high.

4-2-3 Mineral Potential

A prominent copper mineralization zone was identified in the Nepo sub-district. The two outcrops in the Salak River and the upstream of the main Nepo River appear to be in one mineralized zone. The mineralization occurs as quartz vein or silicified vein with chalcopyrite and minor amount of galena. The width of the vein is 1.1 to 1.5 m and the total length the veining zone is expected to continue about 2 km between the two outcrops. Existence of quartz veins are anticipated in the silicified zones in the footwall side and/or northward extension of the Salak River. The deeper zones near the barren quartz veins along the Nepo River should also be investigated.

4-3 Prambon District

4-3-1 Geology and Mineralization

(1) Stratigraphy

The Prambon sub-district is underlain by andesitic and basaltic volcanic and volcaniclastic rocks. The existing map of Ponorogo and Tulungagung quadrangles correlate those volcanic and volcaniclastic rocks to Oligocene-Lower Miocene Mandalika Formation (Tomm, Tommt), Jaten Formation (Tmj), and limestone to Wonosari Formation (Tmwl). It is difficult to define the boundary of Mandalika Formation and Jaten Formation in the Prambon district. Therefore, the volcanic and volcaniclastic rocks that are intercalated with fine volcaniclastic rocks are correlated to the Jaten Formation and the boundary is defined based on the existing geologic map of the Tulungagung Quadrangle.

(a) Mandalika Formation (Tomma)

Distribution: Distributed widely in the western to central part of the district.

Composition: Composed of andesitic-basaltic (Tomma) lava and volcaniclastic rocks. Generally massive volcaniclastic rocks without bedding are abundant and stratigraphy and structure is difficult to clarify, but fine-grained volcaniclastic rocks and mudstone intercalated in some parts. The volcanic and volcaniclastic rocks of the formation are characterized by wide propylitization, while unaltered rocks are exposed in western and other parts.

Structure: Strike E-W to N-S in the northeastern part, and ENE-WSW trending gentle anticline and syncline occur repeatedly southward from the north..

Stratigraphy and correlation: This formation is correlated to Mandalika Formation of the Ponorogo and the Tulungagung Quadrangle sheets,

Thickness: More than 500m.

(b) Jaten Formation (Tmja, Tmjb)

Distribution: Distributed in the Northwestern and southwestern part of the district.

Composition: This is composed of black basalt lava (Tmjb) and andesitic lava and volcaniclastic rocks (Tmja). This formation is bedded with intercalation of green tuff and tuffaceous sandstone. It appears that alteration of the formation is weaker than the alteration of Mandalika Formation.

Structure: This is harmonious with Mandalika Formation. An open synclinal structure is inferred in the western part of the areas.

Stratigraphy and correlation: This formation overlies Mandalika Formation, but partly interfingers with Mandalika Formation.

Thickness: More than 200m.

(c) Wonosari Formation

Distribution: Distributed narrowly in eastern and southern part of the district.

Composition: This is composed of white-gray limestone, and is generally non-bedded and massive. In the district, two types of limestone occurrence are distinguished: thin bed intercalated in andesitic rocks, and massive thick beds exposed usually on the high elevation area. Several beds of the formation are intercalated with andesitic lava of Mandalika Formation. Those rocks may be separated from the Wonosari Formation and be included into the Wonosari Formation.

Structure: Thin beds intercalated with Mandalika Formation obviously appears to be harmonious with Mandalika Formation, but Massive body near ridges appear to be flat lying.

Stratigraphy and correlation: This formation may interfinger with Mandalika Formation. Recent survey is presuming that the lower part of the formation is partly re-crystallized and correlated to the Campurdarat Formation.

Thickness: Less than 300m in the district.

(d) Quaternary volcanic rocks

Distribution: Distributed in northwestern part of the district.

Composition: This is composed of andesitic volcanics and volcaniclastic rocks of the Quaternary including reworked tuffs and lahar deposits. They are distinguished in the field by difference of alteration and consolidations from the Tertiary volcaniclastics.

Stratigraphy and correlation: This formation overlie on the Tertiary rocks uncomformably.

(e) Alluvium: It is widely distributed along current drainages in all over the district. It is composed of boulder, sand and mud.

(2) Intrusive rocks

Diorite to quartz diorite, basalt and andesite intruded into Mandalika and/ore the Jaten Formations.

(3) Geologic structure

Generally massive volcaniclastic rocks without bedding are abundant also in the stratigraphy. Therefore geologic structure is difficult to clarify. But fine-grained volcaniclastic rocks and mudstone intercalated in some parts show gentle dips and open foldings with NE-ＳＷ and N-S trending axes are inferred. In the district, NE-SW trending faults are dominant. One of them running in the eastern part of the district is inferred to displace the limestone largely.

Direction of the intrusive rocks are various as in N-S, NE-SW to ENE-WSW, and NW-SE, but N-S directions are most dominant,

(4) Alteration

The alteration minerals were identified in the field A total of 70 samples was corrected from the Prambon for accurate identification by X-ray diffractometry in the laboratory. Identified alteration minerals are shown in Table 5-4. Of these the following minerals are considered to be related to mineralization. Sericite, mixed-layer clay minerals (smectite/sericite), smectite, kaolin minerals are widely distributed in the northern to central par of the district. The quartz veins and silicified veins described below are emplaced in the alteration zones. But the Pb-Zn veins in the Sumurup and Beloran rivers are emplaced largely in the propylitic alteration. Propylitic and sericite alterations develop also in the central part to the southern part of the district. There are also weak propylitic alteration area along the Tengger River in the northwestern part of the district, where only barren quartz veins and calcite veins. Barren chalcedonic quartz veins are found in the basalt lava of Jaten Formation in the central part of the district.

4-3-2 Mineral Potential

Several prominent mineralization outcrops of base metals and an alteration area are found in the Sumurup River and the Beloran River areas in the central to northern part of the Prambon district (a, b, c, d and e of the list below). A wide argillization area is traversed in the upstream of the Ploso River, but mineralization was not found during this survey (f). No significant mineralization was found in the Jambu River and the Mayong areas in addition to the veins that were found during the phase 2 regional geochemical survey (g and h).

a. Upstream of the Sumurup River: Pb-Zn
b. Down stream of the Sumurup River: Pb-Zn
c. Beloran River: Pb-Zn quartz vein
d. Suren River: Cu vein
e. North of Sengon village: Silicified ledge with pyrite dissemination
f. Upstream of the Ploso River: Argillic alteration
g. Jambu River: Au quartz veins
h. Mayong mountain: Argillic alteration area

The two outcrops (a and b) of a sphalerite-galena-quartz vein zones in the Sumurup River and three outcrops (c) of sphalerite-galena-quartz vein zones in the Beloran River are two of the most prominent mineralization. A zone (d) of with quartz veins with sporadic copper mineralization occurs in the Suren River drainage area, to north of the Sumurup River area. The mineralization occurs as quartz veins or silicified veins with chalcopyrite and minor amount of galena. An outcrop (f) of strongly silicified ledge is identified near the top of mountains between the Sumurup River and Beloran River. Abundant float of strongly silicified rocks were found in several creaks of the areas. Widths of the individual veins range from less than 0.1 m to 1.5 m and the strike lengths of the two Sumurup River veins (a and b) and the Beloran River veins (c) are expected to be more than 500 m. Intensely argillic alteration zones are distributed in the northern part of the district. Within the zones quartz veins and silicification occur, but the width and continuation of the veins are narrower and shorter than the above-mentioned veins in the Sumurup River and Beloran river areas. The vein of the upstream of the Sumurup River is cut at the southern end by weakly silicified andesitic intrusive rock and extension of the vein does not appears to continue to the vein outcrop in the downstream of the Sumurup River. The general trend of the veins may be N-S and dips steeply. Main alteration mode is silicification within wide propylitic envelopes, while argillic alteration occurs in places in the district.

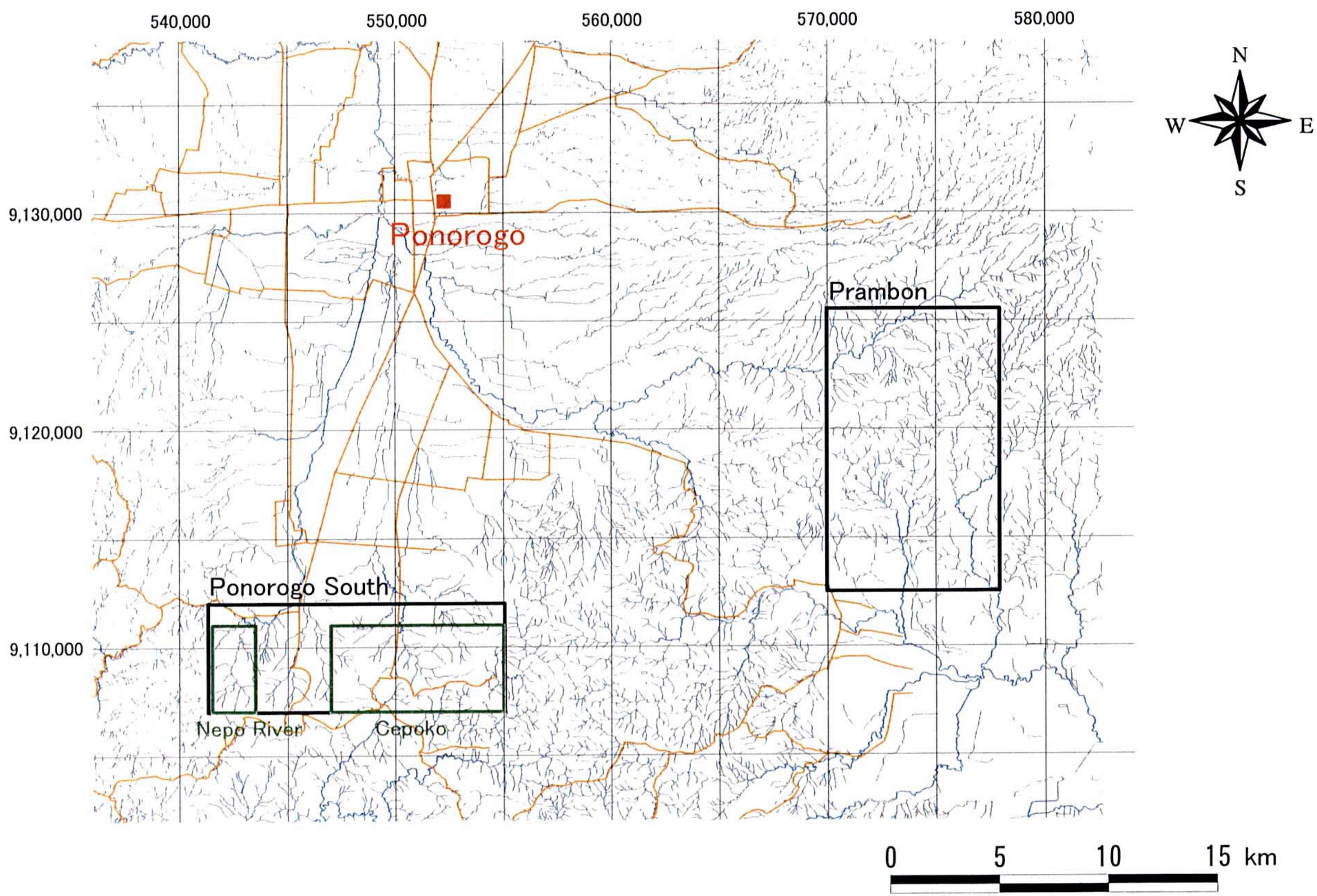


Fig. 5-1 Location Map of the Geological Survey Area

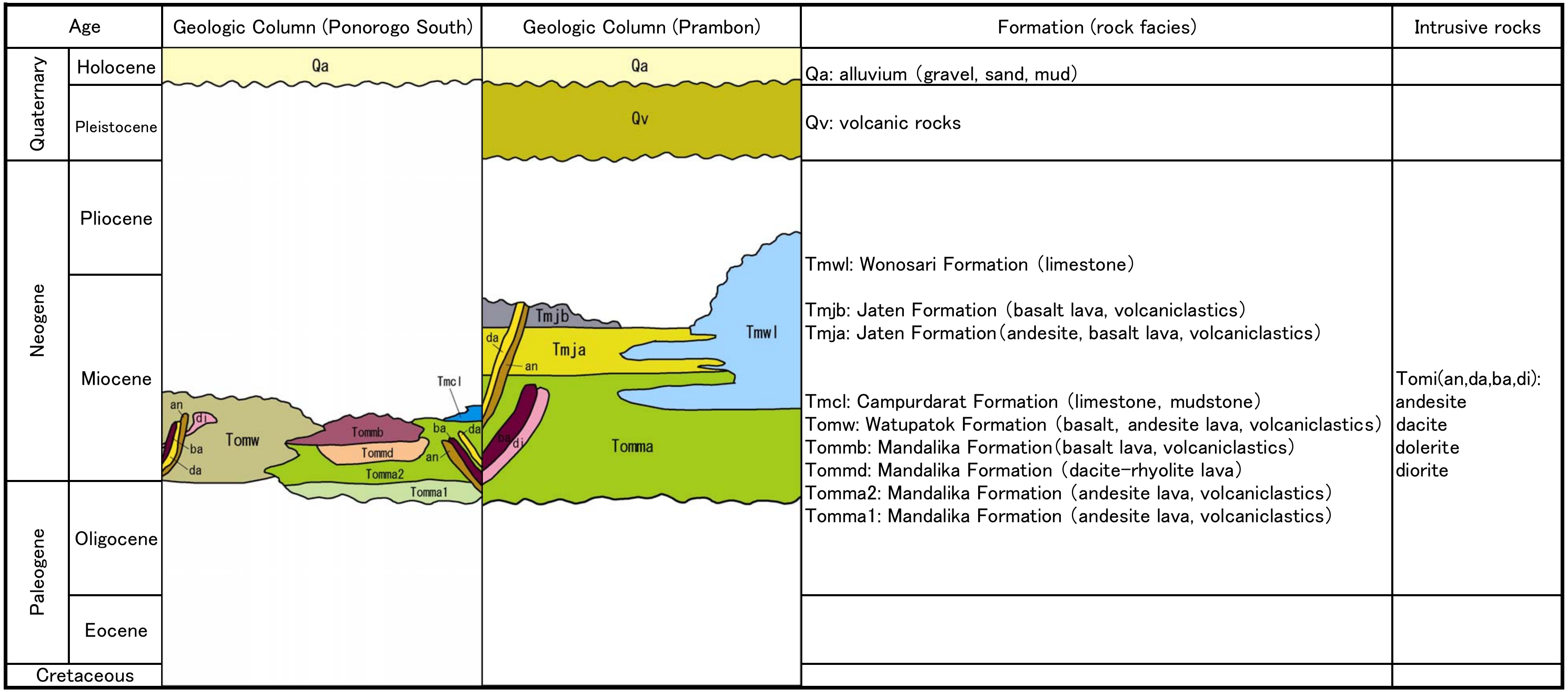


Fig 5-2 Schematic Geologic Column of the Geological Survey Area

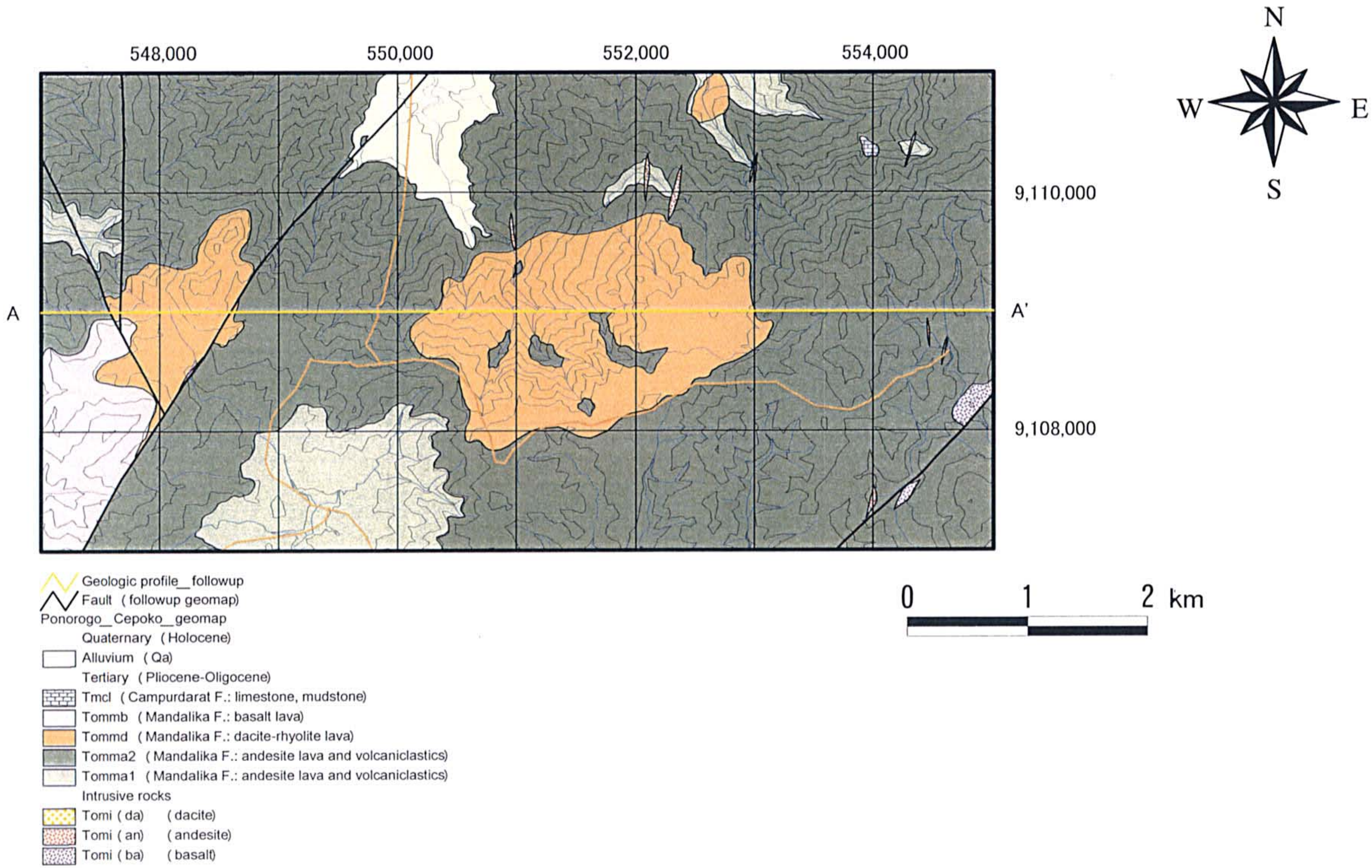


Fig. 5-3 Geologic Map of the Ponorogo South District (Cepoko Sub-district)

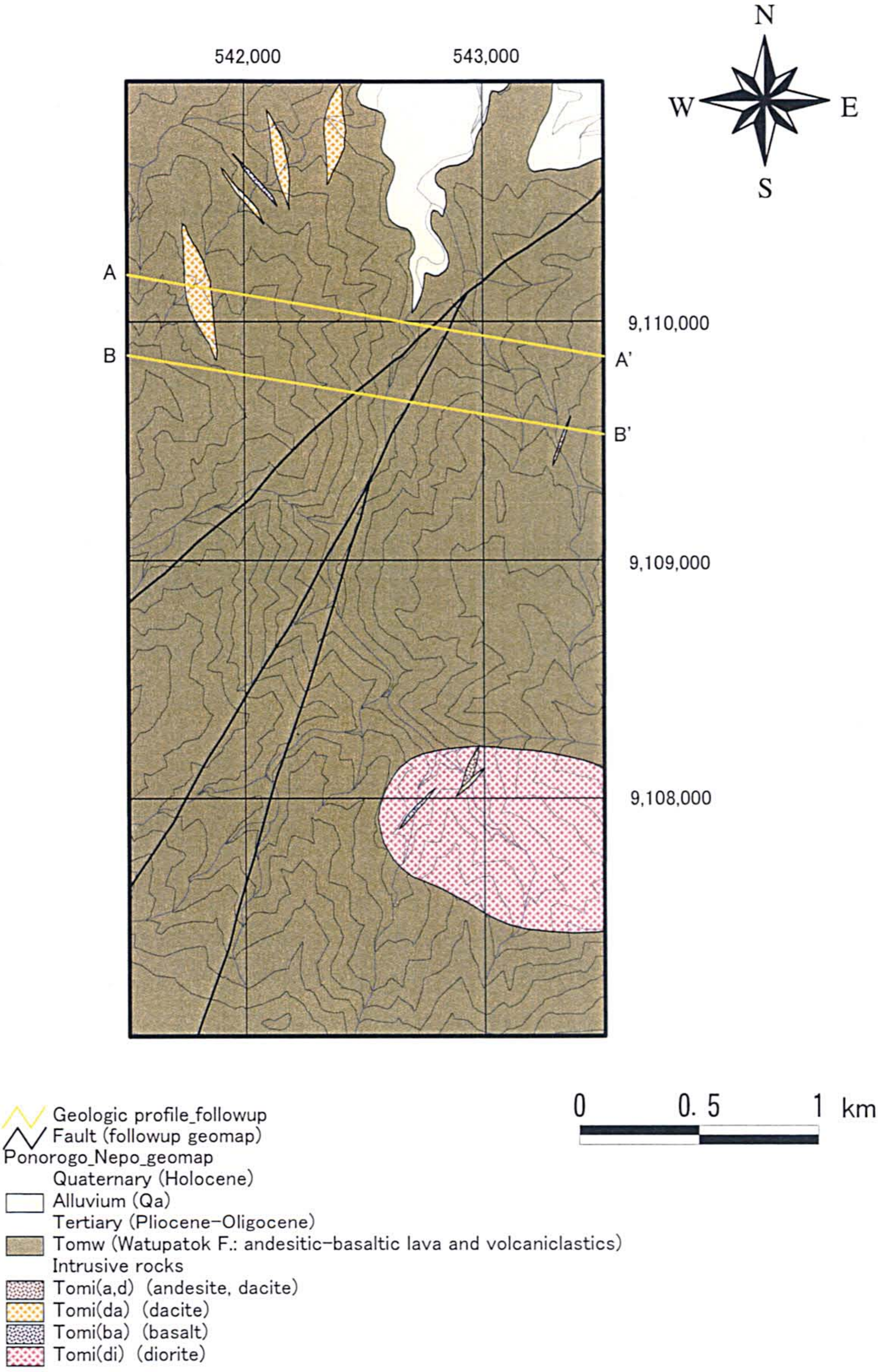
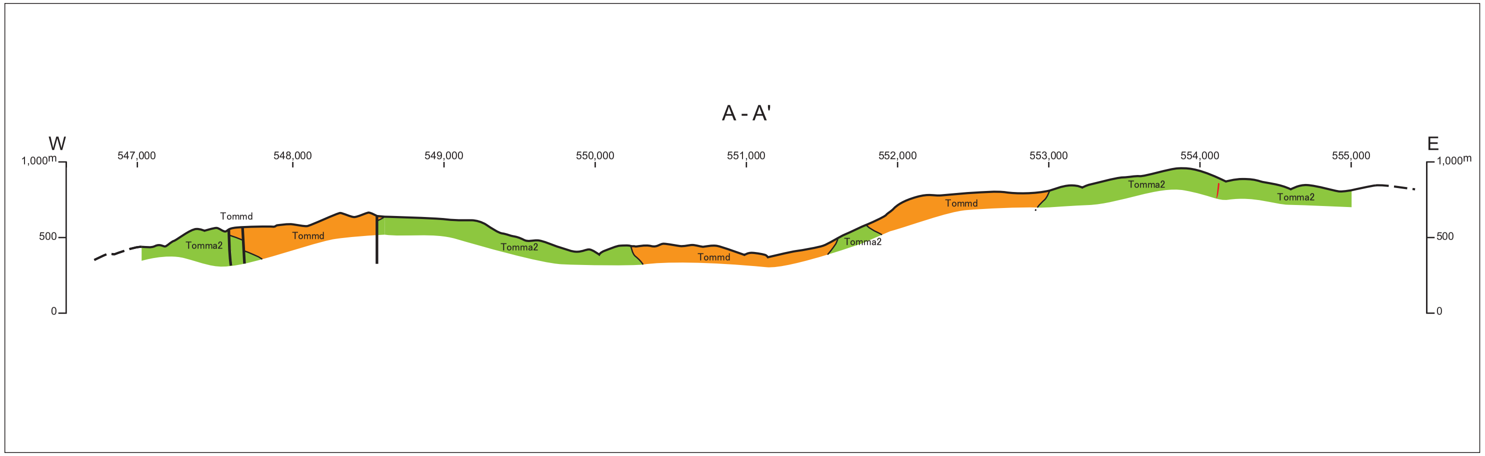


Fig. 5-4 Geologic Map of the Ponorogo South District (Nepo River Sub-district)

Cepoko Sub-district



Nepo River Sub-district

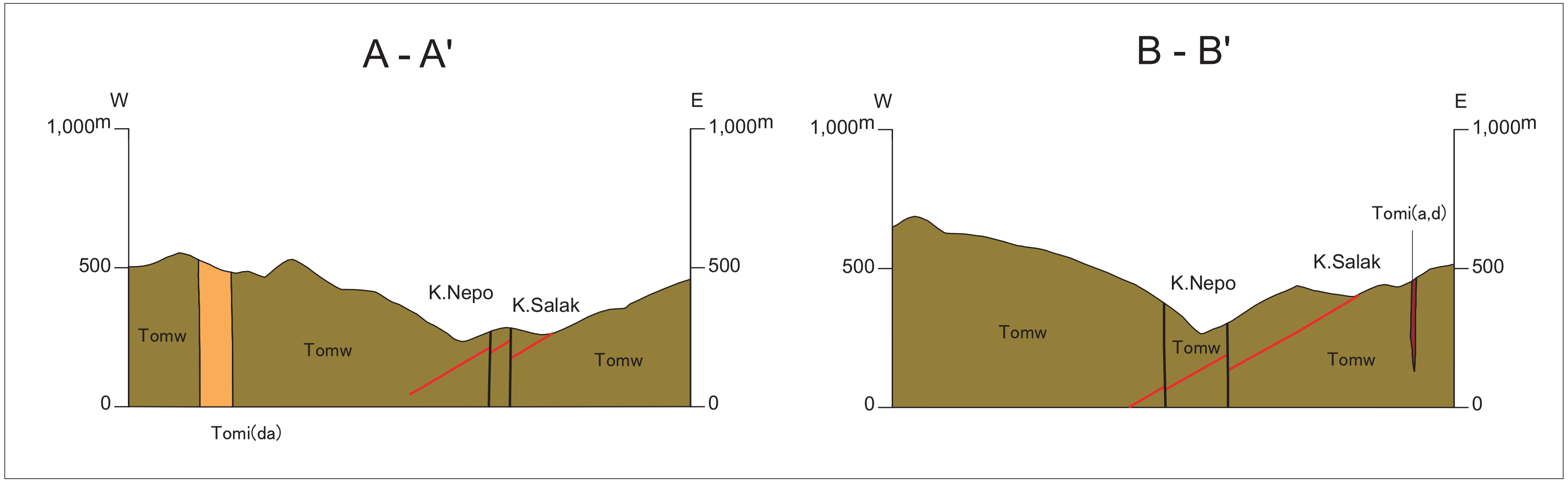


Fig. 5-5 Geologic Profiles of the Ponorogo South District

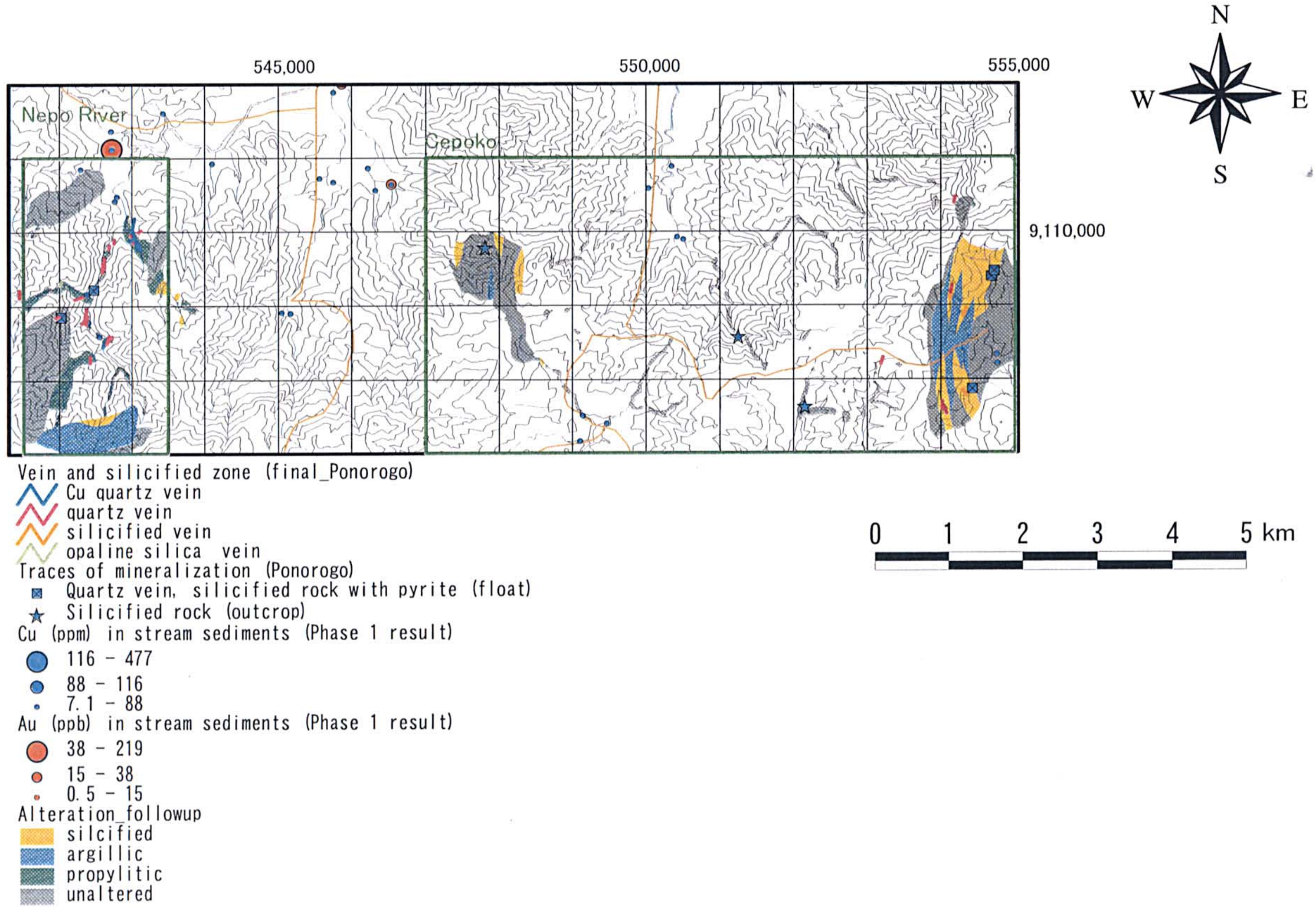


Fig. 5-6 Mineralized Zones of the Geological Survey Area: Ponorogo South District

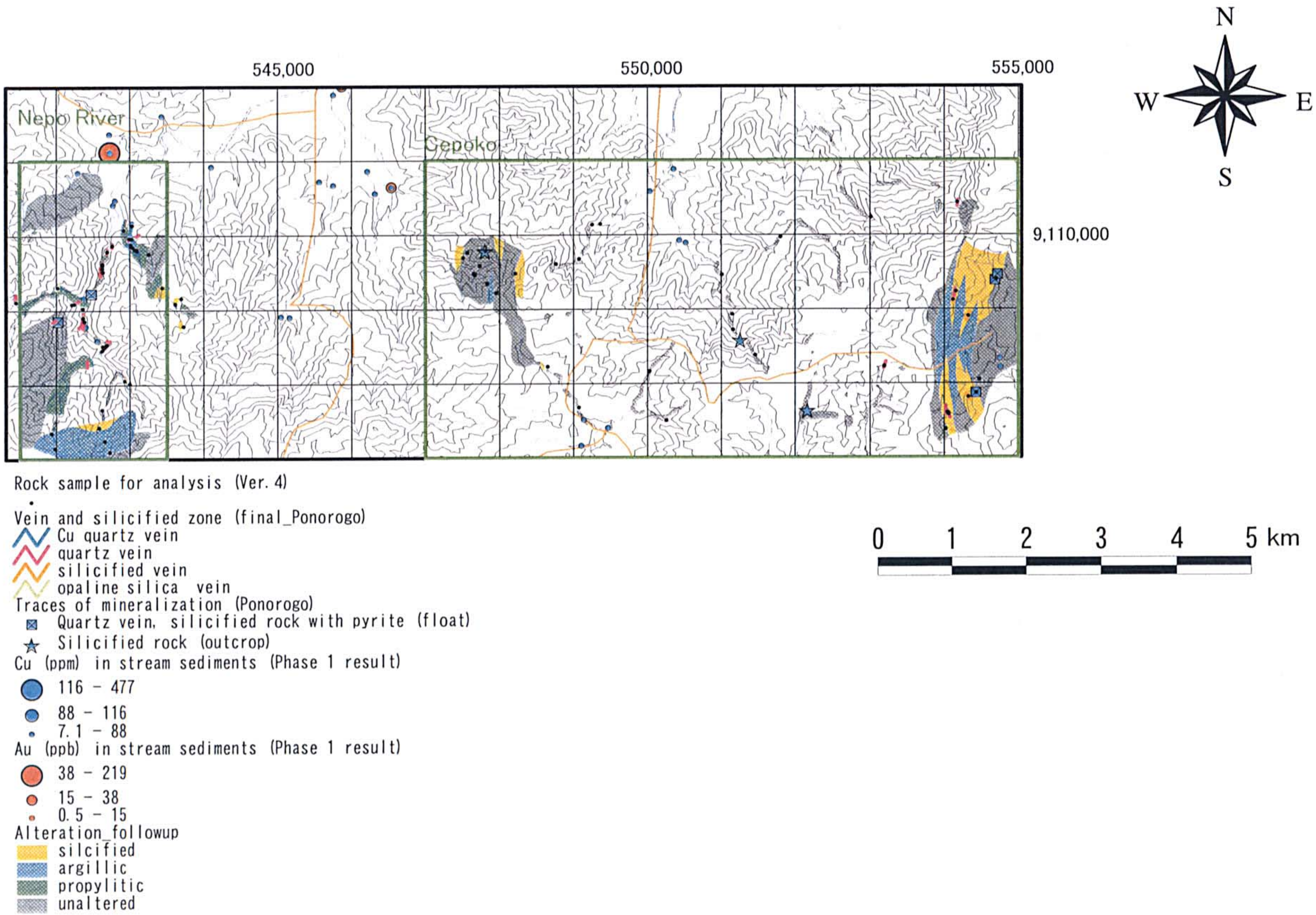


Fig. 5-7 Location Map of Rock Samples: Ponorogo South District

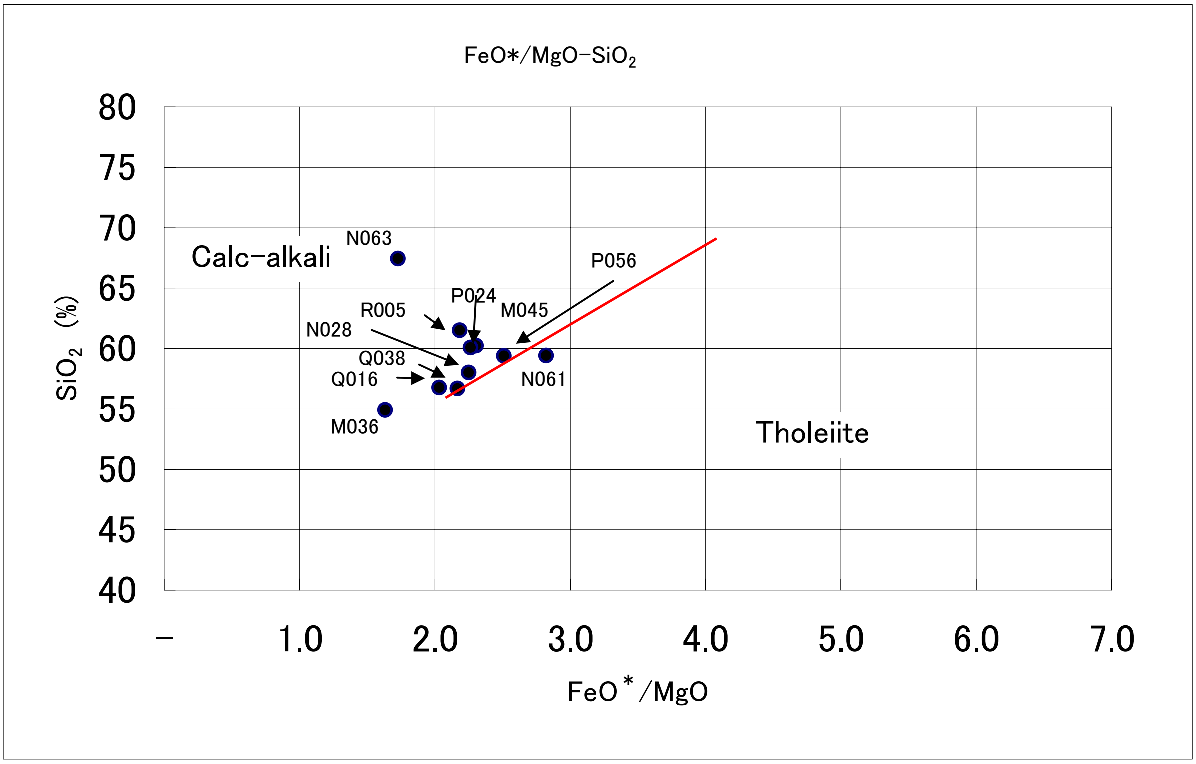
Table 5-1 Results of Microscopic Observation of Thin Sections

Location			Rock name	Texture	Phenocryst /groundmass											Matrix/Fragments		Alteration Mineral										
Sample No.	UTM (E)	UTM (N)			ol	cpx	opx	pl	op	hb	bio	kf	qz	zr	ap	glass	Lithic fragment	qz	leu	ser	kao	chl	cal	sm	ep	zeo	pl	pre
M035T	572,709	9,116,457	andesitic tuff breccia	tuffaceous texture				◎	・	△			○	×	×			○					・	・	・			
M036T	572,900	9,116,320	andesite	porphyritic				○	・	△			△		×			○				△	○	・				
M045T	575,219	9,123,212	diorite	porphyritic, holocrystalline		・	○	◎	・	・						・								○				
M047T	574,885	9,122,910	microdiorite	porphyritic, holocrystalline			△	◎	・	・						△				△				○	×			
M055T	573,662	9,122,966	andesite lava	porphyritic				○	×	・									chl/sm？・					○				
M056T	571,038	9,121,112	andeiste lava(tuff breccia)	porphyritic				◎	・	・			○					△	chl/sm？・						・			
M060T	570,658	9,121,268	basalt	aphyric				◎	・		×		○		×		sphene:×			muscovite:○								
M069T	574,553	9,121,368	andesitic tuff breccia (lava)	porphyritic		○		◎	×							△?								・?				
M081T	574,627	9,120,744	andesitic tuff breccia	porphyritic				◎	・	△			△		×							・	・		×			
M086aT	574,987	9,120,236	basalt lava	porphyritic		△	・?	○	・	・?										chl/sm			・	・	×			
N005T	554,021	9,107,383	andesite	porphyritic		△		○	・						×								・	・				
N008T	550,027	9,108,163	andesite	holocrystalline				◎	・	○			△	×	×							・	・		・			
N009T	550,256	9,107,502	andesite	porphyritic, holocrystalline				○	・	△			○								chl/sm？・			・				
N016T	542,608	9,107,665	andesitic tuff	porphyritic, holocrystalline				○	・	・?			△		×				chl/sm？・			・		×		albite:・		
N021T	571,355	9,117,540	annd. Tuff	porphyritic, holocrystalline				○	×	・			△		×					・		・		・				
N028T	575,604	9,122,531	basalt	porphyritic,amygdaloidal		△		◎	・						×				chl/sm？・					・				
N043T	572,234	9,118,180	andesite?dioritic	porphyritic, holocrystalline				△	・				○										△		・			
N061T	573,735	9,117,518	diorite	porphyritic, holocrystalline				○	・							△			chl/sm？・					・?				
N063T	542,996	9,108,016	diorite	porphyritic, holocrystalline		○		◎	・															・				
P005T	551,804	9,109,972	basalt lava	subequigranular		・	・	◎	×										chl/sm？・				・		・			
P013T	551,155	9,108,720	andesitic tuff breccia	porphyritic		・	△	◎	×									・					・	・				
P014T	551,143	9,108,928	rhyolite	aphyric				◎	×									△		・		△	・	・				
P024T	543,436	9,109,300	basalt	porphyritic,amygdaloidal		○		◎	・									△		・	chl/sm・		×	・				
P042T	542,911	9,110,078	basic andesite to basalt	porphyritic		△	・	◎	×				・											×		×?		
P056T	575,862	9,124,368	microdiorite	porphyritic, holocrystalline		△	△	◎	・				・?								chl/sm？・			・	・	×?		
P060T	575,753	9,123,700	dark gray massive hard basalt	aphyric				◎	・														・	・				
P064T	572,728	9,120,842	andesite	porphyritic				△					△					◎	ser/sm・									
P066T	571,950	9,121,276	fresh andesite	porphyritic		・		◎	・										chl/sm・				・	・		・		
P075T	573,772	9,119,338	porphyritic andesite	porphyritic				△	×				△			・	pumice:△	chalcedonic:△						×		×?		
P084T	574,511	9,118,183	qtz float with pyrite	-		△		◎	×									・	chl/sm？・				・	・		×		
P089T	574,237	9,118,070	dark green basic andesite	aphyric, amygdaloidal				○	・				△					・						×		albite:○		
Q002T	553,009	9,110,230	green altered andesite	aphyric, amygdaloidal				△										△?					・	・				
Q003T	549,076	9,109,676	green alt. tuff bre.- vol. bre	tuffaceous texture		○		○	×			・				△			chl/sm？・					・				
Q005T	548,759	9,109,608	rhyolite	porphyritic		・		◎	・	△						○												
Q016T	571,441	9,116,436	black basalt	porphyritic		・	×	◎	・							△			sm/chl・				・	・				
Q021T	570,750	9,117,130	rhyolite?	equigranular				◎	・	○		・	・	×	×				chl/sm？・			actinolite?・						
Q024T	570826	9117352	porphylitic dacite (dike?)	glassy-aphanitic		・		△	・			chalcedonic・				◎												
Q032T	572,899	9,121,246	porphylitic andesite	sub-porphyritic		△		○	・	・?										biotite?chl/sm・								
Q038T	573811	9121565	andesite? dike?	porphyritic, holocrystalline				◎	×						×			◎				・	・	・				
R002T	547,560	9,109,762	andesite	porphyritic		△?		△	・										chl/sm？・			・	・	・	・			
R005T	547,731	9,109,588	andesite	porphyritic				○	・		・?	△	◎	×	×			・		・		△	・	△	△			
R020T	572,836	9,122,268	andesite	porphyritic		○		◎	・							△												
S014T	548,648	9,108,228	Breccia dyke	porphyritic				○	・	△?			○					・		・		・	・	・	・			
S015T	549,071	9,107,680	tuff	tuffaceous texture				○	・				△					◎	chl/sm？・				○			albite:○		
S018T	570,554	9,115,966	basalt	porphyritic				◎	・				・					△	chl/sm？・						・			
S023T	574,249	9,125,192	porphyritic andesite	porphyritic		△		◎	・	×	×					△			chl/sm？・									
S030T	572,215	9,119,970	diorite?	porphyritic, holocrystalline	△?			◎	×							○			chl/sm？・				・					
S034T	573,229	9,118,410	andtic tf bre	porphyritic				○	×				△			・		○	chl/sm？・				△		・			
S035T	573,993	9,118,022	dacite dyke	porphyritic				○					△					◎		△								
S049T	543,027	9,109,962	porphyritic And	porphyritic, holocrystalline		△	・	◎	・										chl/sm？・					・				

ol:olivine, cpx:clino-pyroxene, opx:ortho-pyroxene, op:opaque mineral, hb:hornblende, bio:biotite
kf:potash-feldspar, qz:quartz,zr:zircon, ap:apatite, frag:fragment,leu:leucoxene, ser:sericite, kao:kaolin, cal:calcite, sm:smectite, ep:epidote
chl:chlorite, zeo:zeolite, pl:plagioclase, pre:prehnite, ill: illite, zr: zircon
Amount:◎>○>△>・>×

Table 5-2 Results of Whole Rock Analysis

Element	UTM (N)	UTM (E)	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	Cr2O3	SrO	BaO	LOI	Sum
Analysis Method			XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF	XRF
Analysis Unit			%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Detection Limit			0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.001	0.01	0.01	0.01	0.01	0.01	0.01
M036W	9,116,320	572,900	54.88	16.86	5.17	4.08	3.46	0.79	7.41	0.15	0.73	0.14	0.07	0.02	0.03	5.92	99.71
M045W	9,123,212	575,219	60.20	16.92	5.62	2.41	3.65	0.87	6.18	0.19	0.63	0.12	0.10	0.03	0.03	2.55	99.50
N028W	9,122,531	575,604	57.99	16.72	6.27	2.48	3.75	1.15	6.21	0.12	0.71	0.12	0.01	0.02	0.03	3.23	98.81
N061W	9,117,518	573,735	59.39	16.62	5.22	1.94	3.94	1.07	6.09	0.18	0.55	0.14	0.01	0.03	0.03	4.28	99.49
N063W	9,108,016	542,996	67.41	13.47	0.50	2.40	4.98	0.61	4.61	0.08	0.70	0.17	0.03	<0.01	0.02	3.06	98.04
P024W	9,109,300	543,436	60.05	13.35	0.54	4.27	5.38	0.14	10.76	0.11	1.10	0.17	<0.01	<0.01	0.02	4.22	100.10
P056W	9,124,368	575,862	59.37	16.38	5.22	2.22	3.27	0.53	6.20	0.15	0.59	0.14	0.01	0.02	0.02	4.56	98.68
Q016W	9,116,436	571,441	56.73	16.68	6.51	3.25	3.24	1.70	7.35	0.12	0.83	0.14	<0.01	0.02	0.03	2.74	99.34
Q038W	9,121,565	573,811	56.67	16.90	7.35	2.75	3.18	0.42	6.63	0.16	0.68	0.12	0.01	0.03	0.03	4.56	99.49
R005W	9,109,588	547,731	61.48	14.76	3.11	2.31	2.25	2.79	5.61	0.22	0.71	0.20	<0.01	0.01	0.04	6.38	99.87



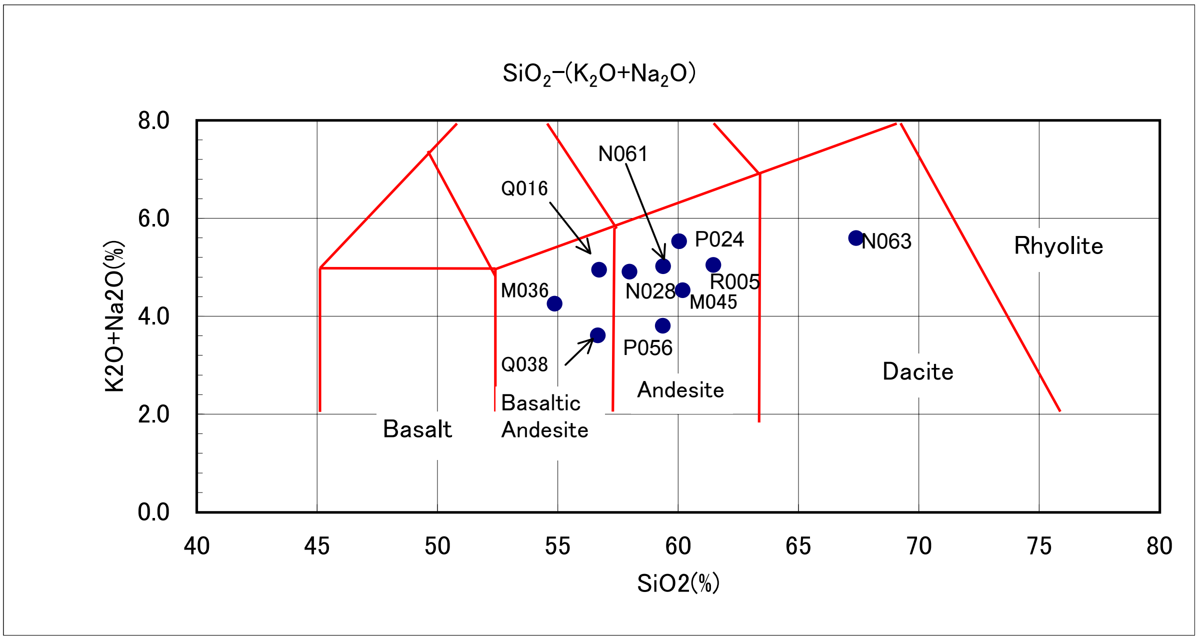


Fig. 5-8 Diagrams of Volcanic Rocks in the Geological Survey Area

Table 5-3 Results of Xray Diffraction Analysis (1/2)

Sample No.	Quartz	Plagioclase	Mica/Illite	Smectite	Chlorite	Pyrite	Others
M006X	D	SD		A	A		Cal (A)
M009X	D	A	A				Dol(A), Ms(A), F'(A)
M015X	D		A		Tr-A	Tr	J(Tr)
M019X	D		A				J(Tr), F'(Tr)
M022X	A	D			SD		
M035X	D	A	A		SD		Cal(A)
M042X	D	A	SD		Tr-A		
M044X	D		D			Tr	Ana(Tr)
M052X	SD		D				
M059X	D	A	Tr-A	Tr-A			Sph(Tr)
M065X	D		A				Cal(A)
M067X	D		A			Tr	
M068X	D						ML(A)
M078X	D		A			Tr	
M084X	D		A			A	Ga(Tr), Ana(Tr)
M089X	D		SD			Tr	Ana(Tr)
N001X	D	A-SD	A	A			K(Tr)
N004X	D	A			Tr	A	F'(A)
N006X	D	SD			Tr	Tr-A	
N007X	D	Tr-A		Tr	Tr		
N011X	D		SD			Tr	
N013X	D	A		A	Tr-A		Biotite(A)
N019X	D	A			Tr		Cal(A)
N029X	D						ML(A), Di(A)
N032X	D	A		A	Tr-A	Tr-A	Cal(A)
N034X	D	A				Tr	ML(SD)
N040X	D						
N041X	A	A		D		Tr	
N045X	D	A	A	SD			?Sph(Tr)
N047X	A	D		A			?Sph(Tr)
N048X	A			D		Tr	F'(A)
N049X	D	Tr		D		Tr	K(A), Dol(A)
N055X	D					A	PJ(Tr)
N057X	D					SD	ML(A)
N060X	D					A	ML(A), Apy(Tr)
P011X	SD	D				Tr	
P017X	A	D		Tr-A			J(Tr-A)
P028X	D	A			Tr-A		Cal(A)
P030X	D	Tr	Tr		Tr		
P031X	D		Tr				Go(Tr)
P033X	SD	D			A		
P034X	D						Cpy(A),Sph(Tr),Ga(Tr)
P035X	D					Tr	Cpy(A),Sph(Tr),Ga(Tr),Ce(Tr)
P037X	D		Tr		Tr	Tr	Sph(Tr)
P038X	D	Tr				Tr	Sph(Tr),Ga(Tr-A),Ang(Tr)
P040X	D	Tr	Tr-A		Tr-A	Tr-A	
P041X	D	SD					Cal(A)
P082X	SD	D	A			A	
P083X	D		Tr-A				Go(Tr)
P086X	△		・	○			

Ana	Anatase	Dol	Dolomite	J	Jarosite
Ang	Anglesite – $PbSO_4$	Dol'	Ferroan dolomite or ankerite	K	Kaolinite
Ap	Apatite			ML	Mixed-layer clay
Apy	Arsenopyrite	F'	K-feldspar	Ms	Magnesite
Cal	Calcite	Ga	Galena	Pj	Plumbojarosite
Ce	Cerussite – $PbCO_3$	Go	Goethite	Sid	Siderite
Cpy	Chalcopyrite	Gy	Gypsum	Sph	Sphalerite
Di	Dickite	Hem	Hematite	St	Stilbite

The mixed-layer clay (ML) is very probably interstratified smectite-illit

D= Dominant. Used for the component apparently most abundant, regardless of its probable percentage level.
CD= Co-dominant. Used for two (or more) predominating components, both or all of which are judged to be present, in roughly equal amounts.
SD= Sub-dominant. The next most abundant component(s) providing its percentage level is judged above about 20.
A= Accessory. Components judged to be present between the levels of roughly 5 and 20%.
Tr= Trace. Components judged to be below about 5%.

Table 5-3 Results of Xray Diffraction Analysis (2/2)

Sample No.	Quartz	Plagioclase	Mica/Illite	Smectite	Chlorite	Pyrite	Others
P087X	D		SD				J(Tr),Ana(Tr)
P088X	D	SD	A-SD			Tr	
P090X	D		A			Tr	J(Tr)
P091X	D		Tr-A			Tr	
P095X	D		Tr			Tr-A	Cpy(Tr),Sph(A),Ga(Tr),K(Tr)
P097X	D		A			Tr	Ga(Tr)
Q006X	D	A	A		A		
Q008X	D	Tr-A			Tr	Tr	ML(SD),J(Tr)
Q009X	D	A		SD	A	Tr	
Q026X	A			D		A	
Q027X	A	A		D	A		Cal(A)
Q029X	SD			D		A	St(A),K(Tr),Cal(Tr)
Q031X	SD			A		A	ML(D)
Q033	D		SD		A	A	
Q035X	D		A-SD		A	Tr	Sph(Tr)
Q037X	D					Tr	
Q039X	D	SD	SD		A	Tr	
Q043X	D		SD	A	A	Tr	
Q044X	D		SD		Tr-A	Tr-A	
Q048X	D		SD			A	ML(A),Sid(A),K(Tr-A)
Q051X	Tr-A		D		Tr-A	Tr	Dol(A),Dol'(A),K(A),Sid(Tr-A)
Q053X	D		SD			Tr-A	Sph(Tr),Ce(Tr)
Q060X	SD					Tr-A	ML(D),J(Tr),Ana(Tr)
Q062X	D		A-SD				Ana(Tr)
Q065X	D		SD			Tr	Ana(Tr),J(Tr)
Q066X	D					Tr	ML(A),Ana(Tr),J(Tr)
Q070X	D					Tr	ML(SD),Ana(Tr),J(Tr)
Q071X	D					Tr	ML(A),Ana(Tr)
Q072X	D						ML(SD),Ana(Tr)
Q073X	D						ML(A),F'(Tr),?Ap(Tr)
R012X	D	Tr-A	A-SD				
R014X	D	A	SD	A			
R015X	D	A	SD		A	A	
R019X	D	A	A		A	Tr	
R020X	D	A	A-SD		A		Cal(A)
R021X	D	A	A-SD		Tr-A	Tr	Ga(Tr)
R022X	D		SD				Go(Tr-A),F'(Tr)
R023X	D	A	SD		Tr-A		
R024X	D		A				J(Tr)
R025X	D		A			Tr	K(Tr),Ga(Tr)
R026X		Tr		D			Gy(A),Go(Tr),K(Tr)
S007X	D		A				Hem(Tr)
S008X	D		A				F'(Tr),K(Tr)
S009X	D		Tr-A				F'(Tr),K(Tr)
S020X	D	A	A				Gy(Tr)
S022X	D		A				F'(Tr-A)
S025X	A		SD	Tr-A		A	
S031X	D	A	A			Tr	Cal(A)
S037X	D					Tr	ML(A),Sph(Tr-A),Ga(Tr),K(Tr)
S040X	D				A	Tr	ML(A-SD)

Ana	Anatase	Dol	Dolomite	J	Jarosite
Ang	Anglesite – $PbSO_4$	Dol'	Ferroan dolomite or ankerite	K	Kaolinite
Ap	Apatite			ML	Mixed-layer clay
Apy	Arsenopyrite	F'	K-feldspar	Ms	Magnesite
Cal	Calcite	Ga	Galena	Pj	Plumbojarosite
Ce	Cerussite – $PbCO_3$	Go	Goethite	Sid	Siderite
Cpy	Chalcopyrite	Gy	Gypsum	Sph	Sphalerite
Di	Dickite	Hem	Hematite	St	Stilbite

The mixed-layer clay (ML) is very probably interstratified smectite-illit

D= Dominant. Used for the component apparently most abundant, regardless of its probable percentage level.
CD= Co-dominant. Used for two (or more) predominating components, both or all of which are judged to be present, in roughly equal amounts.
SD= Sub-dominant. The next most abundant component(s) providing its percentage level is judged above about 20.
A= Accessory. Components judged to be present between the levels of roughly 5 and 20%.
Tr= Trace. Components judged to be below about 5%.

Table 5-4 Results of Microscopic Observation of Polished Sections (1/2)

Sample	Ore minerals										Gangue minerals					
No.	Py	Cp	Sph	Asp	Co	Aca	Gn	Cer	Bar	others	si	ser	pl	kf	chl	others
M013	◎	△					・			S(・)	◎	△				
M016	◎	△	○		・						◎					
M071	◎		○				△	○			◎	◎				
M075	◎	○	△				・				◎					
M077	◎		△		・		・	・		S(・)	◎	○				
M088	○									Goe(△)	◎	△				
M103	○		○	・			△				◎	△				(Al,P)oxide(○)
N004	◎	○							・	Ja(△)	◎	△		◎		
N007	○	・			・		・			Goe(△)	◎	△		△	△	
N039	○		△				・	・			◎					
N053	◎		△	・			△				◎					
N055	○		◎	△			△	△			◎					
N059							◎			Ang(○)S(△)	△					
N060	◎			◎			・				◎	○				
N062	○						・	・			◎					
P028	○	○					△	・	△		◎	○	○		△	
P030		・								Goe(△)	◎	○	○		△	
P032	・				△				・	Goe(△)	◎	△				
P033	○	△	・								◎	△			△	bio(△)
P035	○	◎	△		・		・				◎					
P037	△	△	○				○	○			◎	△				
P038	△	○	・						・	Goe(△)	◎				△	
P041	△	△	○				○				◎					
P049	○	△								Goe(△)	◎	○				
P085	○		△				・				◎	◎				cal(○)
P086	○		・								◎					

Abbreviation:
Py=pyrite,Cer=cerusite,Cp=chalcopyrite,Asp=arsenopyrite, Gn=galena, Goe=goethite, Aca=acanthite, Ja=jarosite, Co=covellite
Sph=sphalerite, Sch=scheelite, Bis=bismuthinite, Bar=barite, S=sulpher, Ang=anglesite, Zn=Zn oxide
si=SiO2 minerals, pl=plagioclase, chl=chlorite or clay minerals, epi=epidote, cal=calcite, kao=kaollinite, tit=titanite
kf=K-feldspar, se=sericite or muscovite, bio=biotite, apa=apatite,
◎=abundant, ○=common, △=small, ・=rare

Table 5-4 Results of Microscopic Observation of Polished Sections (2/2)

Sample	Ore minerals									Gangue minerals					
No.	Py	Cp	Sph	Asp	Co	Aca	Gn	Cer	Bar	others	si	ser	pl	kf	chl	others
P088	○									Ja(△)	○	○	◎			
P090	△									Ja(○)Goe(△),Bis(・)	◎					kao(△)
P095	△		◎				○	△			◎		△			
P096	○		○				・				◎					
P097	○		△				△	・			◎	○			△	
P103	○		◎				◎	△			◎					
P104	◎		○				△			S(○)	◎	○				
Q040	○									Goe(△)	◎		◎			tit(△)
Q050	○		◎				○			Ja(○)	◎	○				
Q052	◎	・	◎				△				◎	○				
Q054	◎		○				○			S(○)	◎					
Q058	○	・	△				△				◎	○				
Q067	○						・				◎	○				
Q068	◎		○	△			△			S(△)	◎	△				
Q074	○		・				・		・		◎					
Q075	○		・			・	・		△		◎			○		
R025	○	○					◎	△			◎					
R030	○		・				・				◎					
R031	○						・			Sch(・)	◎	○				apa(△)
S009	△						・		・	Goe(△)	◎	△		△	△	
S037	○		△				△			Zn(△)	◎	△				
S038	○		○				○	△			◎	△				
S039	○		◎				○				◎					
S040	△		△				○				◎	○				

Abbreviation:
Py=pyrite,Cer=cerusite,Cp=chalcopyrite,Asp=arsenopyrite, Gn=galena, Goe=goethite, Aca=acanthite, Ja=jarosite, Co=covellite
Sph=sphalerite, Sch=scheelite, Bis=bismuthinite, Bar=barite, S=sulpher, Ang=anglesite, Zn=Zn oxide
si=SiO2 minerals, pl=plagioclase, chl=chlorite or clay minerals, epi=epidote, cal=calcite, kao=kaollinite, tit=titanite
kf=K-feldspar, se=sericite or muscovite, bio=biotite, apa=apatite,
◎=abundant, ○=common, △=small, ・=rare

Table 5-5 Homogenization Temperatures and Salinities of Fluid Inclusions

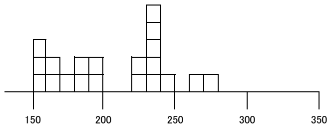
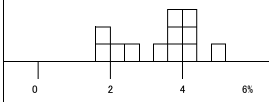
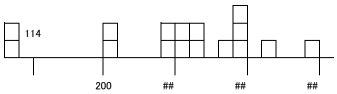
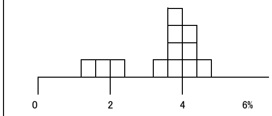
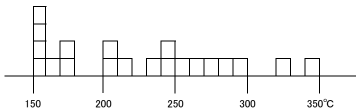
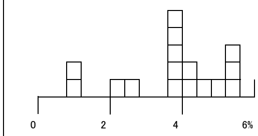
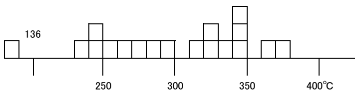
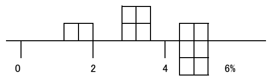
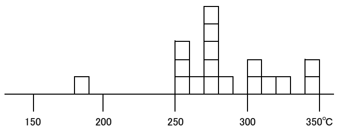
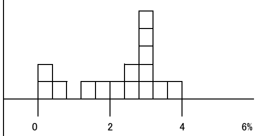
	Temperature	Salinity	
P036F number: 20 average **207** ℃ maximum: 275 ℃ minimum: 155 ℃ standard deviation: 62 ℃			number: 12 average **3.5** % maximum: 5.4 % minimum: 1.8 % standard deviation: 1.2 %
N004F number: 16 average 249 ℃ maximum: 346 ℃ minimum: 114 ℃ standard deviation: 64 ℃			number: 12 average 3.6 % maximum: 4.8 % minimum: 1.6 % standard deviation: 1.0 %
Q052F number: 20 average 227 ℃ maximum: 348 ℃ minimum: 154 ℃ standard deviation: 60 ℃			number: 16 average 3.8 % maximum: 5.4 % minimum: 0.9 % standard deviation: 1.4 %
S037F number: (exclude 3 sample 18 average 297 ℃ maximum: 371 ℃ minimum: 136 ℃ standard deviation: 59 ℃			number: 9 average 3.3 % maximum: 5.0 % minimum: 1.5 % standard deviation: 1.2 %
M016F number: 17 average 283 ℃ maximum: 344 ℃ minimum: 189 ℃ standard deviation: 37 ℃			number: 15 average 2.3 % maximum: 3.7 % minimum: 0.4 % standard deviation: 1.1 %

Table 5-6 Statistic Data of Geochemical Analysis

Element	Au	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	In	K	La	Li	Mg	Mn	Mo
Unit	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm
n	164	197	200	162	200	200	190	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	193
average	**0.01**	**0.16**	**9.48**	**3**	**209**	**0.68**	**0.09**	**0.67**	**0.36**	**20**	**27**	**9**	**0.8**	**88**	**7.02**	**20**	**0.27**	**2.5**	**0.08**	**0.71**	**8.7**	**10.7**	**1.62**	**1,444**	**0.51**
S.D.	0.06	0.23	0.94	4	93	0.17	0.10	0.34	0.39	7	8	6	0.5	88	1.31	2	0.06	1.0	0.02	0.53	3.0	2.6	0.64	486	0.54
min	0.00	0.02	7.48	0.2	36	0.36	0.01	0.13	0.02	8	5	1	0.1	10.3	2.70	16	0.07	0.4	0.05	0.07	4.3	4.9	0.35	546	0.05
max	**0.71**	**2.65**	**13.00**	**42**	**590**	**1.26**	**0.66**	**2.02**	**2.53**	**48**	**44**	**40**	**3.8**	**908**	**10.10**	**27**	**0.42**	**6.6**	**0.13**	**4.65**	**21.8**	**23.1**	**5.15**	**3,640**	**3.86**
average+S.D.	0.07	0.39	10.42	7	302	0.85	0.19	1.01	0.75	27	35	16	1.3	176	8.33	22	0.33	3.5	0.09	1.24	11.7	13.3	2.26	1,930	1.05
average+2XS.D.	0.12	0.62	11.36	11	396	1.01	0.28	1.34	1.14	34	43	22	1.8	265	9.64	24	0.39	4.5	0.11	1.78	14.7	15.9	2.90	2,416	1.60
average+3XS.D.	0.18	0.85	12.30	15	489	1.18	0.38	1.68	1.54	41	51	28	2.3	353	10.95	26	0.44	5.5	0.13	2.31	17.7	18.5	3.54	2,902	2.14

S.D.: standard deviation

References

Phase 1 average(817 samples)	0.004	0.25	2.04	4.65	92.1	0.36	8.76	0.704	0.65		22.5	35.7		33	8.48					0.086			0.585	1,270	0.600
Average amount in Crustal Rocks (Mason, B and Moore,C.B.; 1982)																									
Crustal Average	0.004	0.07	8.13	1.8	425	2.8	0.2	3.63	0.2	60	25	100	3	55	5	15	1.5	3	0.1	2.59	30	2.8	2.09	950	1.5
Granite(G-1)	0.004	0.05	7.43	0.5	1,220	3.0	0.07	0.99	0.03	170	2.4	20	1.5	13	1.37	20	1.1	5.2	0.02	4.51	101	3	0.24	195	6.5
Diabase(W-1)	0.004	0.08	7.94	1.9	160	0.8	0.08	7.83	0.15	23	47	114	0.9	110	7.76	16	1.4	2.7	0.07	0.53	9.8	0.8	3.99	1280	0.57

Element	Ni	Nb	Ni	P	Pb	Rb	Re	S	Sb	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr	Hg
Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
n	200	200	200	200	200	200	41	190	68	96	199	200	100	85	200	200	193	200.0	200	114	200	200	200	193
average	**10**	**1**	**10**	**499**	**28**	**16.1**	**0.002**	**0.02**	**0.11**	**2.0**	**0.8**	**98**	**0.07**	**0.09**	**1.4**	**0.48**	**0.15**	**0.5**	**253**	**0.19**	**20**	**166**	**60**	**0.02**
S.D.	6	1	6	215	51	12.0	0.000	0.01	0.11	0.6	0.5	51	0.02	0.06	0.6	0.10	0.15	0.3	88	0.29	7	150	28	0.01
min	0.9	0	1	120	1	1.3	0.002	0.01	0.05	1.0	0.2	22	0.05	0.05	0.3	0.19	0.02	0.2	36	0.10	10	47	10	0.01
max	**59**	**3**	**59**	**1,500**	**459**	**92.4**	**0.003**	**0.06**	**0.68**	**4.0**	**5.1**	**344**	**0.16**	**0.37**	**3.9**	**0.86**	**1.79**	**2.6**	**481**	**2.90**	**45**	**1,210**	**164**	**0.14**
average+S.D.	16	1	16	714	79	28.2	0.002	0.02	0.22	2.5	1.2	149	0.09	0.14	2.1	0.58	0.31	0.8	340	0.48	27	316	88	0.04
average+2XS.D.	23	2	23	929	131	40.2	0.003	0.03	0.34	3.1	1.7	200	0.12	0.20	2.7	0.68	0.46	1.1	428	0.76	34	466	116	0.05
average+3XS.D.	29	3	29	1,144	182	52.2	0.003	0.04	0.45	3.7	2.2	251	0.14	0.26	3.3	0.78	0.61	1.4	515	1.05	41	616	144	0.07

S.D.: standard deviation

References

Phase 1 average(817 samples)	12.2	0	12.2	180	8.5	0	0.000	0.0	2.51	0	0.0	59.67	0	0	0	0.351	0	0	367	5	0	121	0.0	0.018
Average amount in Crustal Rocks (Mason, B and Moore,C.B.; 1982)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustal Average	75	20	75	1050	13	90	0.001	0.026	0.20	0.05	2	375	0	0.01	7.2	0.44	0.5	1.8	135	1.5	33	70	165	0.08
Granite(G-1)	1	24	1	390	48	220	<0.002	0.0058	0.31	0.007	3.5	250	0	<1	50	0.15	1.2	3.4	17	0.4	13	45	210	0.1
Diabase(W-1)	76	9.5	76	610	7.8	21	<0.002	0.0123	1.0	0.3	3.2	190	0	<1	2.4	0.64	0.11	0.58	264	0.5	25	86	105	0.2

Note: n: number of samples that are higher than the lower detection limit of the element.

Table 5-7 Correlation Coefficients of Elements in Soil Samples

Element	Au	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr	Hg
Au	1.00	0.98	−0.04	0.52	0.03	−0.03	0.31	−0.05	0.70	−0.01	−0.06	0.08	0.14	0.46	−0.03	−0.01	0.00	−0.15	0.23	0.22	0.01	0.03	−0.04	0.11	0.03	0.05	0.19	0.08	0.07	0.97	0.23	−0.07	0.42	0.22	0.09	0.07	−0.05	0.21	0.63	−0.02	−0.05	0.26	−0.08	−0.04	0.18	−0.12	0.67	−0.15	0.72
Ag		1.00	−0.04	0.51	0.06	−0.03	0.34	−0.06	0.71	0.01	−0.08	0.06	0.18	0.52	−0.04	−0.01	−0.02	−0.17	0.26	0.24	0.03	0.03	−0.05	0.11	0.06	0.05	0.22	0.06	0.09	0.96	0.26	−0.08	0.46	0.23	0.10	0.10	−0.06	0.23	0.65	−0.02	−0.07	0.30	−0.08	−0.06	0.21	−0.11	0.67	−0.17	0.78
Al			1.00	−0.05	0.34	0.72	−0.06	−0.50	−0.14	0.42	0.09	−0.08	0.28	0.26	0.00	0.51	0.16	0.68	−0.21	−0.11	0.48	0.41	−0.18	0.09	0.06	−0.28	0.09	0.08	0.08	0.03	0.03	0.29	−0.04	−0.09	0.10	0.11	−0.27	0.02	−0.07	0.60	0.04	0.21	0.20	−0.05	−0.03	0.40	−0.11	0.64	−0.04
As				1.00	0.20	−0.06	0.23	0.27	0.42	0.11	−0.10	−0.15	0.17	0.36	−0.09	−0.24	−0.22	−0.13	0.22	−0.08	0.17	0.22	−0.33	0.16	0.59	−0.21	0.44	−0.16	−0.17	0.51	−0.07	−0.08	0.37	0.65	0.04	0.11	0.06	0.41	0.41	0.02	−0.07	0.54	0.41	−0.07	0.49	−0.02	0.29	−0.11	0.39
Ba					1.00	0.44	−0.09	0.04	−0.14	0.69	0.24	−0.08	0.26	0.26	0.09	0.16	0.01	0.27	−0.10	−0.14	0.64	0.24	−0.34	0.52	0.21	−0.28	0.34	−0.01	−0.12	0.08	0.04	0.10	0.12	0.09	0.04	−0.01	0.21	0.16	−0.11	0.58	0.16	0.48	0.49	0.07	0.16	0.23	−0.04	0.31	0.06
Be						1.00	−0.02	−0.35	−0.16	0.73	−0.06	−0.11	0.46	0.13	−0.21	0.37	0.12	0.56	−0.30	0.17	0.76	0.51	−0.36	−0.01	0.07	−0.10	0.09	0.19	0.24	0.05	0.39	0.22	−0.04	−0.05	0.07	0.22	−0.24	−0.05	−0.10	0.81	−0.17	0.36	0.36	−0.29	−0.03	0.55	−0.29	0.55	−0.05
Bi							1.00	−0.14	0.52	0.04	−0.19	−0.13	−0.02	0.33	−0.15	−0.10	−0.15	−0.33	0.59	0.16	0.02	−0.14	−0.13	−0.07	0.26	0.08	0.24	−0.14	0.24	0.39	0.13	0.04	0.41	0.14	0.42	0.58	−0.16	0.24	0.83	−0.10	−0.21	0.27	−0.03	−0.18	0.14	−0.09	0.20	−0.31	0.38
Ca								1.00	−0.13	−0.05	−0.13	−0.19	−0.23	−0.17	−0.16	−0.59	−0.42	−0.24	−0.29	−0.35	−0.06	0.09	−0.25	−0.02	0.18	−0.28	0.25	−0.16	−0.32	−0.09	−0.32	0.02	0.04	0.31	−0.13	−0.26	0.47	0.26	−0.14	−0.07	−0.14	−0.03	0.36	−0.09	0.38	−0.38	−0.20	−0.20	−0.06
Cd									1.00	−0.12	−0.24	−0.05	0.01	0.29	−0.16	−0.13	−0.15	−0.37	0.50	0.24	−0.09	−0.16	0.03	0.04	0.18	0.31	0.19	−0.09	0.21	0.73	0.11	−0.10	0.37	0.24	0.01	0.34	−0.20	0.22	0.75	−0.27	−0.25	0.23	−0.20	−0.18	0.18	−0.10	0.62	−0.39	0.52
Ce										1.00	0.16	−0.02	0.31	0.18	−0.05	0.25	0.07	0.39	−0.19	−0.04	0.92	0.43	−0.44	0.33	0.24	−0.24	0.21	0.20	0.09	0.10	0.20	0.20	0.04	0.07	0.11	0.15	−0.07	0.01	−0.07	0.81	−0.01	0.50	0.62	−0.13	0.02	0.49	−0.21	0.43	0.01
Co											1.00	0.65	−0.18	0.14	0.94	0.71	0.62	0.03	0.09	−0.40	0.12	−0.17	0.27	0.69	−0.11	−0.31	−0.16	0.47	−0.21	−0.06	−0.26	0.16	−0.15	−0.22	0.24	−0.48	0.00	−0.24	−0.27	0.18	0.89	0.02	0.19	0.92	−0.31	−0.13	0.41	0.07	−0.12
Cr												1.00	−0.13	0.05	0.66	0.53	0.63	−0.15	0.00	−0.02	−0.01	−0.18	0.43	0.33	−0.22	0.02	−0.26	0.70	0.07	0.10	0.03	0.16	−0.09	−0.22	0.15	−0.38	−0.14	−0.32	−0.11	0.01	0.59	−0.05	−0.09	0.64	−0.34	−0.21	0.43	−0.14	0.03
Cs													1.00	0.19	−0.20	0.09	0.03	0.09	−0.05	0.49	0.38	0.33	−0.22	−0.04	0.05	0.02	0.23	0.01	0.27	0.21	0.67	−0.20	0.09	0.12	0.11	0.19	−0.06	0.12	0.05	0.35	−0.12	0.52	0.06	−0.23	0.16	0.28	−0.02	0.12	0.17
Cu														1.00	0.16	0.25	0.14	−0.01	0.32	0.00	0.20	0.16	−0.09	0.18	0.28	−0.25	0.21	0.08	0.07	0.53	0.09	−0.01	0.41	0.23	0.29	0.09	−0.07	0.19	0.45	0.19	0.15	0.37	0.11	0.13	0.22	0.04	0.42	0.02	0.80
Fe															1.00	0.68	0.63	−0.06	0.19	−0.37	−0.03	−0.28	0.31	0.60	−0.11	−0.28	−0.19	0.37	−0.26	−0.03	−0.30	0.15	−0.10	−0.20	0.18	−0.47	−0.04	−0.24	−0.19	0.03	0.89	−0.05	0.08	0.97	−0.31	−0.25	0.54	−0.04	−0.05
Ga																1.00	0.70	0.32	0.05	−0.09	0.27	0.01	0.16	0.36	−0.13	−0.16	−0.20	0.49	0.10	0.05	0.04	0.16	−0.15	−0.27	0.30	−0.22	−0.32	−0.29	−0.15	0.37	0.62	0.14	0.05	0.61	−0.40	0.18	0.32	0.35	−0.02
Ge																	1.00	0.18	0.00	0.02	0.06	0.01	0.26	0.28	−0.20	−0.09	−0.36	0.48	0.13	0.00	0.06	0.13	−0.09	−0.27	0.23	−0.30	−0.14	−0.41	−0.17	0.17	0.59	0.00	−0.07	0.58	−0.41	0.05	0.27	0.19	−0.03
Hf																		1.00	−0.45	−0.17	0.38	0.51	−0.23	0.05	−0.04	−0.39	−0.10	−0.03	0.02	−0.16	−0.13	0.27	−0.10	−0.12	−0.07	−0.05	−0.10	−0.11	−0.35	0.55	0.01	0.05	0.33	−0.11	−0.08	0.53	−0.33	0.97	−0.19
In																			1.00	0.09	−0.19	−0.36	0.07	0.13	0.20	0.20	0.16	−0.19	0.05	0.25	−0.02	−0.25	0.27	0.06	0.27	0.33	−0.18	0.16	0.55	−0.39	0.15	0.17	−0.13	0.18	0.02	−0.03	0.44	−0.44	0.27
K																				1.00	−0.01	0.02	0.23	−0.36	−0.14	0.61	−0.03	0.12	0.51	0.23	0.89	−0.16	0.13	−0.08	−0.06	0.38	−0.08	−0.07	0.29	−0.12	−0.31	0.21	−0.36	−0.38	−0.08	0.24	0.04	−0.18	0.24
La																					1.00	0.44	−0.45	0.27	0.29	−0.24	0.28	0.24	0.09	0.11	0.23	0.24	0.05	0.13	0.07	0.18	−0.09	0.06	−0.06	0.85	−0.02	0.52	0.64	−0.11	0.08	0.52	−0.16	0.41	0.02
Li																						1.00	−0.26	−0.06	0.16	−0.25	0.14	0.12	0.02	0.07	0.12	0.07	0.08	0.14	−0.03	0.04	0.07	0.12	−0.12	0.50	−0.20	0.27	0.47	−0.31	0.23	0.36	−0.26	0.54	0.05
Mg																							1.00	0.06	−0.33	0.52	−0.36	0.43	0.15	−0.07	0.08	−0.02	−0.19	−0.29	−0.07	−0.23	0.17	−0.28	−0.11	−0.42	0.33	−0.40	−0.50	0.33	−0.33	−0.13	0.31	−0.25	−0.03
Mn																								1.00	0.08	−0.25	0.06	0.17	−0.18	0.13	−0.26	0.13	−0.03	−0.05	0.08	−0.26	0.10	−0.04	−0.09	0.21	0.56	0.22	0.30	0.57	−0.05	−0.03	0.42	0.08	0.03
Mo																									1.00	−0.19	0.52	−0.18	−0.04	0.07	−0.14	0.02	0.24	0.66	0.19	0.32	0.03	0.43	0.25	0.10	−0.09	0.46	0.50	−0.11	0.44	0.10	−0.07	−0.01	0.14
Na																										1.00	−0.19	0.15	0.36	0.03	0.43	−0.18	−0.06	−0.14	−0.25	0.26	−0.07	−0.16	0.13	−0.36	−0.26	−0.19	−0.50	−0.27	−0.19	0.12	0.09	−0.43	0.04
Nb																											1.00	−0.21	0.01	0.23	0.05	−0.10	0.35	0.41	0.31	0.44	0.18	0.88	0.34	0.14	−0.09	0.39	0.33	−0.16	0.75	−0.06	0.04	−0.10	0.18
Ni																												1.00	0.24	0.12	0.24	0.14	−0.11	−0.15	0.08	−0.31	−0.12	−0.30	−0.14	0.25	0.35	0.04	0.00	0.32	−0.29	0.11	0.21	0.01	0.04
P																													1.00	0.12	0.50	−0.06	0.04	−0.10	0.21	0.36	−0.15	−0.08	0.24	0.05	−0.17	0.18	−0.26	−0.29	−0.12	0.28	−0.08	0.03	0.12
Pb																														1.00	0.27	−0.04	0.45	0.23	0.15	0.12	−0.08	0.23	0.68	0.05	−0.07	0.35	−0.05	−0.06	0.21	−0.10	0.69	−0.15	0.76
Rb																															1.00	−0.16	0.10	−0.07	0.07	0.29	−0.07	−0.06	0.21	0.19	−0.22	0.32	−0.21	−0.32	−0.07	0.24	0.00	−0.11	0.25
Re																																1.00	0.01	−0.07	−0.07	−0.02	−0.03	−0.14	0.04	0.30	0.02	0.00	0.17	0.10	−0.08	−0.10	0.00	0.20	−0.04
S																																	1.00	0.22	0.23	0.32	−0.03	0.37	0.60	0.00	−0.11	0.26	0.08	−0.10	0.37	−0.08	0.27	−0.12	0.50
Sb																																		1.00	0.03	0.11	0.10	0.44	0.25	0.01	−0.21	0.46	0.33	−0.19	0.53	−0.02	0.03	−0.10	0.23
Se																																			1.00	0.20	0.02	0.26	0.31	0.05	0.32	0.28	0.11	0.20	0.13	−0.08	0.07	−0.02	0.10
Sn																																				1.00	−0.21	0.40	0.54	0.00	−0.41	0.20	0.00	−0.48	0.32	0.23	−0.12	−0.11	0.16
Sr																																					1.00	0.15	−0.19	−0.06	0.11	−0.06	0.14	0.02	0.23	−0.21	−0.08	−0.04	−0.07
Ta																																						1.00	0.39	−0.05	−0.19	0.22	0.19	−0.20	0.85	−0.12	0.07	−0.13	0.22
Te																																							1.00	−0.19	−0.26	0.31	−0.14	−0.21	0.33	−0.16	0.44	−0.37	0.62
Th																																								1.00	0.04	0.37	0.57	−0.05	0.02	0.38	−0.21	0.58	−0.02
Ti																																									1.00	−0.01	0.10	0.92	−0.27	−0.12	0.42	0.05	−0.10
Tl																																										1.00	0.46	−0.08	0.23	0.25	0.07	0.13	0.26
U																																											1.00	0.05	0.25	0.26	−0.20	0.38	−0.09
V																																												1.00	−0.27	−0.30	0.52	−0.08	−0.08
W																																													1.00	−0.14	0.03	−0.10	0.26
Y																																														1.00	−0.33	0.55	−0.12
Zn																																															1.00	−0.35	0.55
Zr																																																1.00	−0.19
Hg																																																	1.00

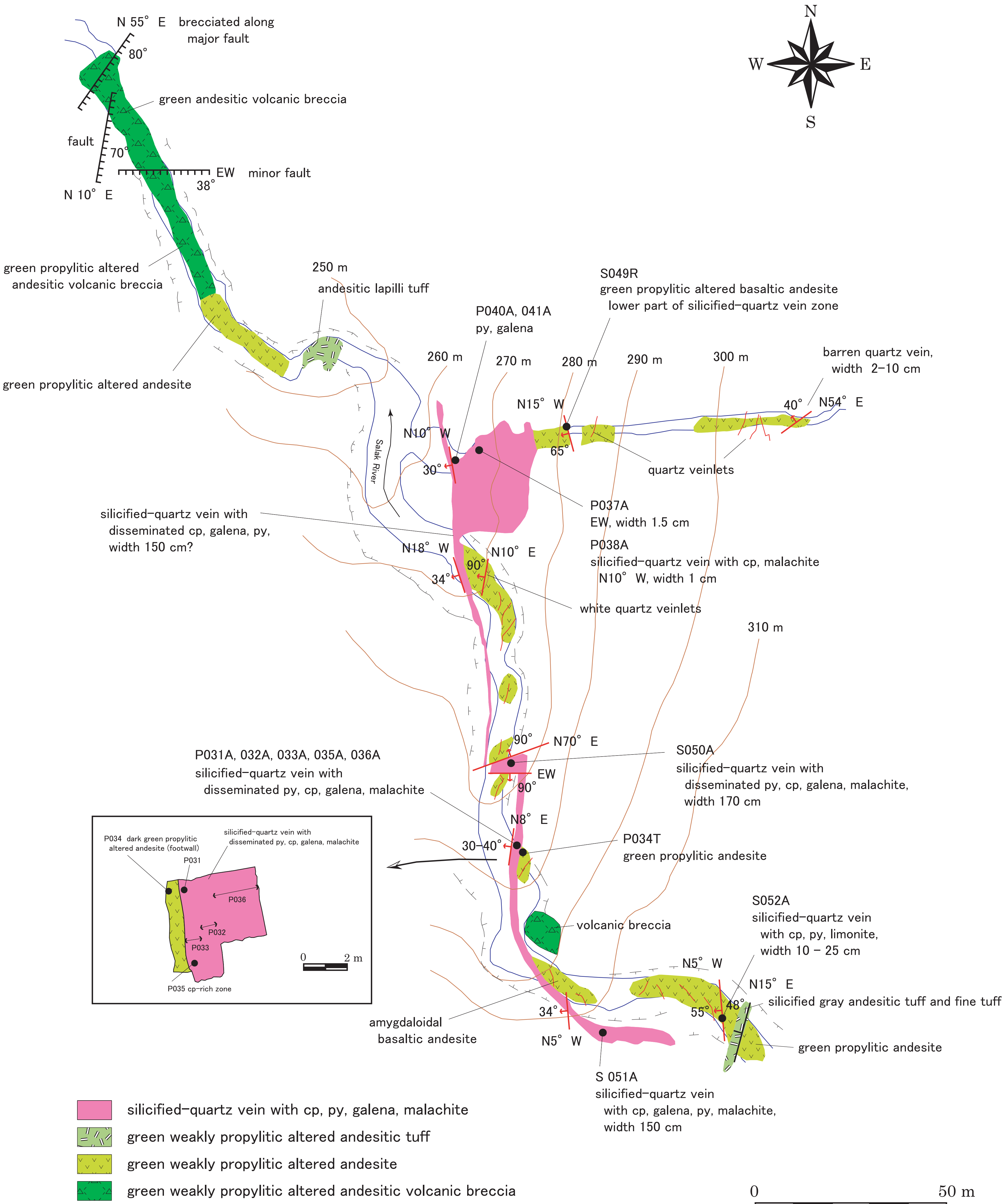


Fig. 5-9 Sketch of Outcrop of the Quartz Vein along the Salak River, Ponorogo South District

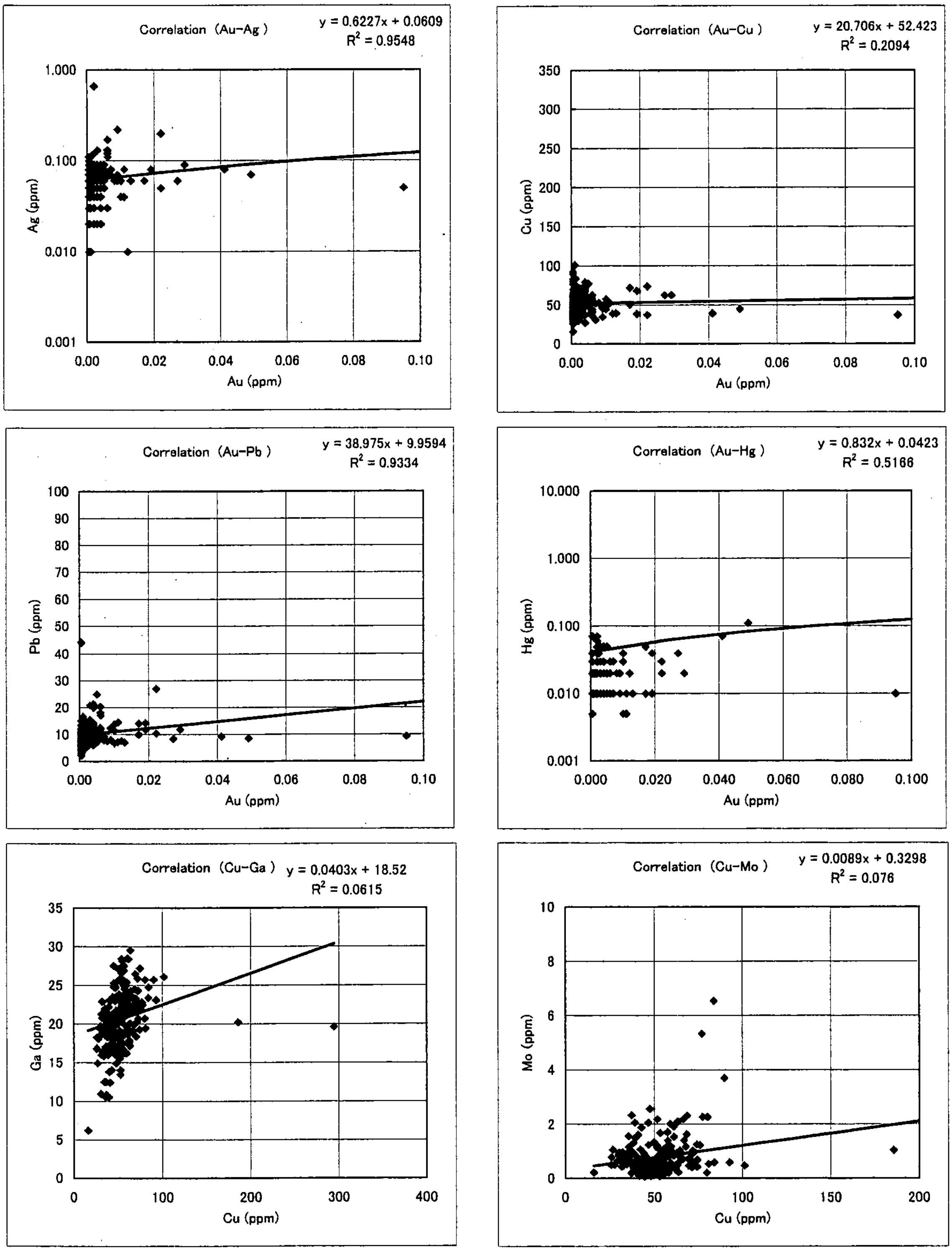


Fig. 5-11 Correlations between Elements in Soil Samples (1/2)

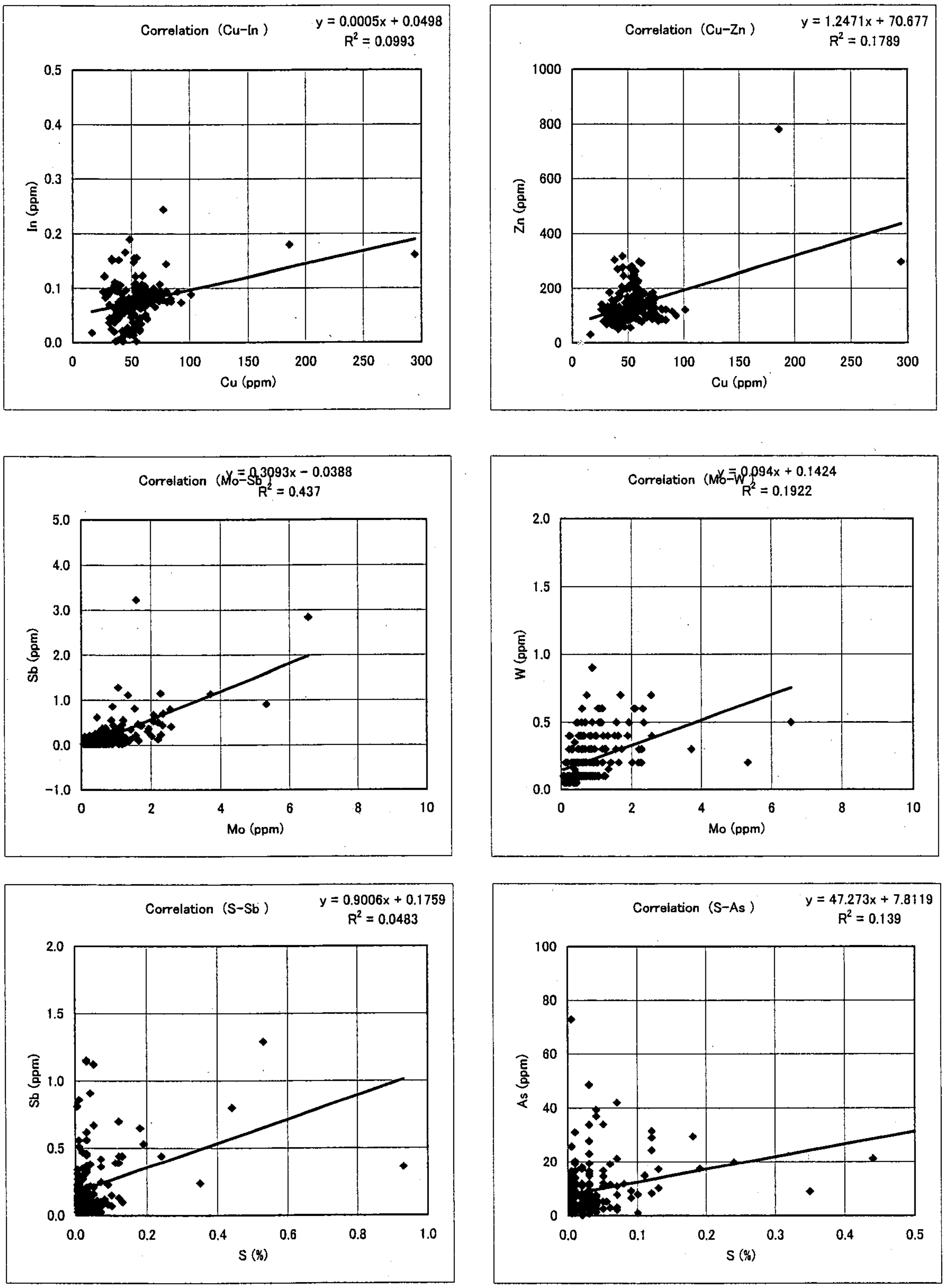


Fig. 5-11 Correlations between Elements in Soil Samples (2/2)

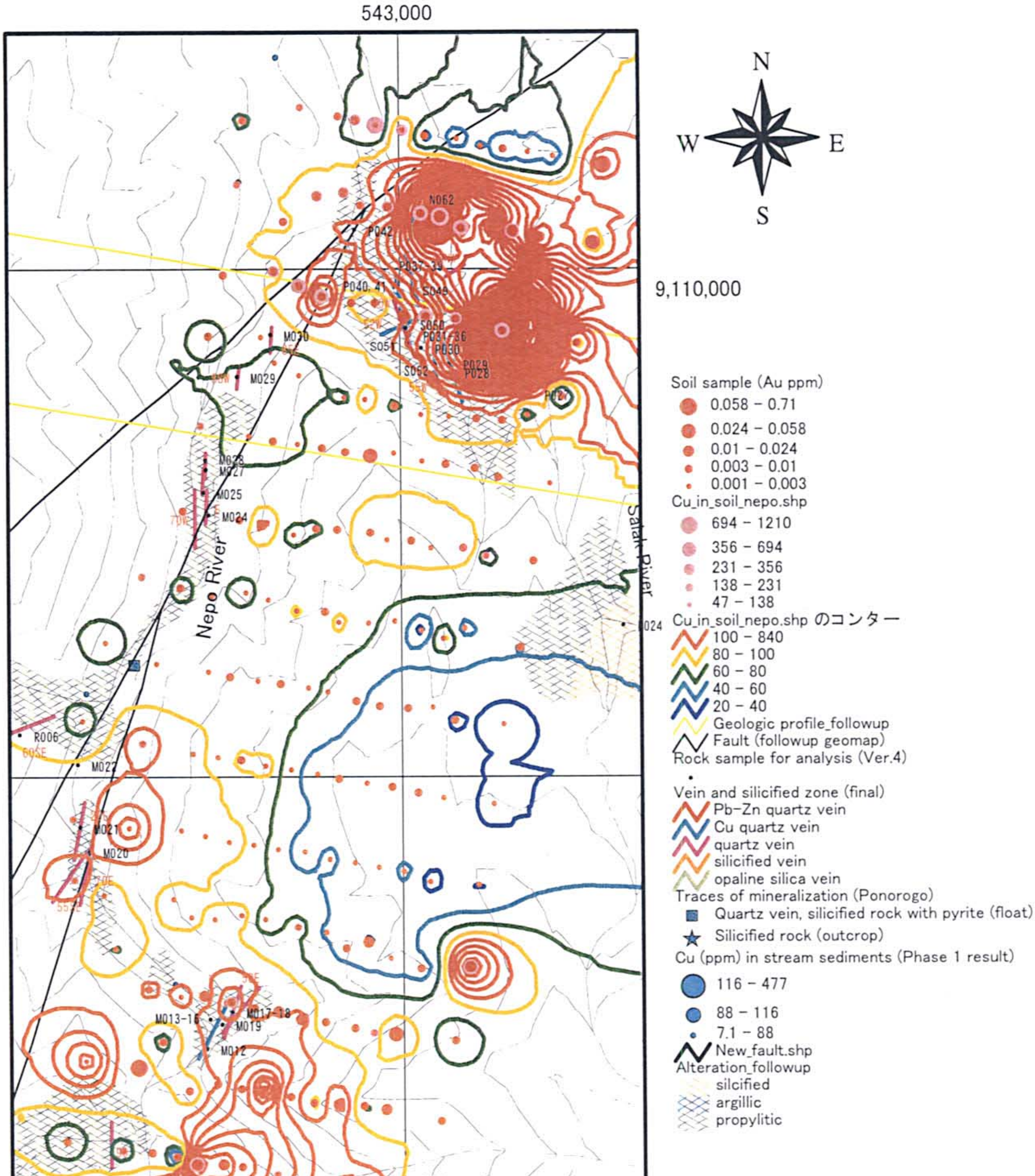


Fig. 5-12 Geochemical Anomaly Map of the Ponorogo South District

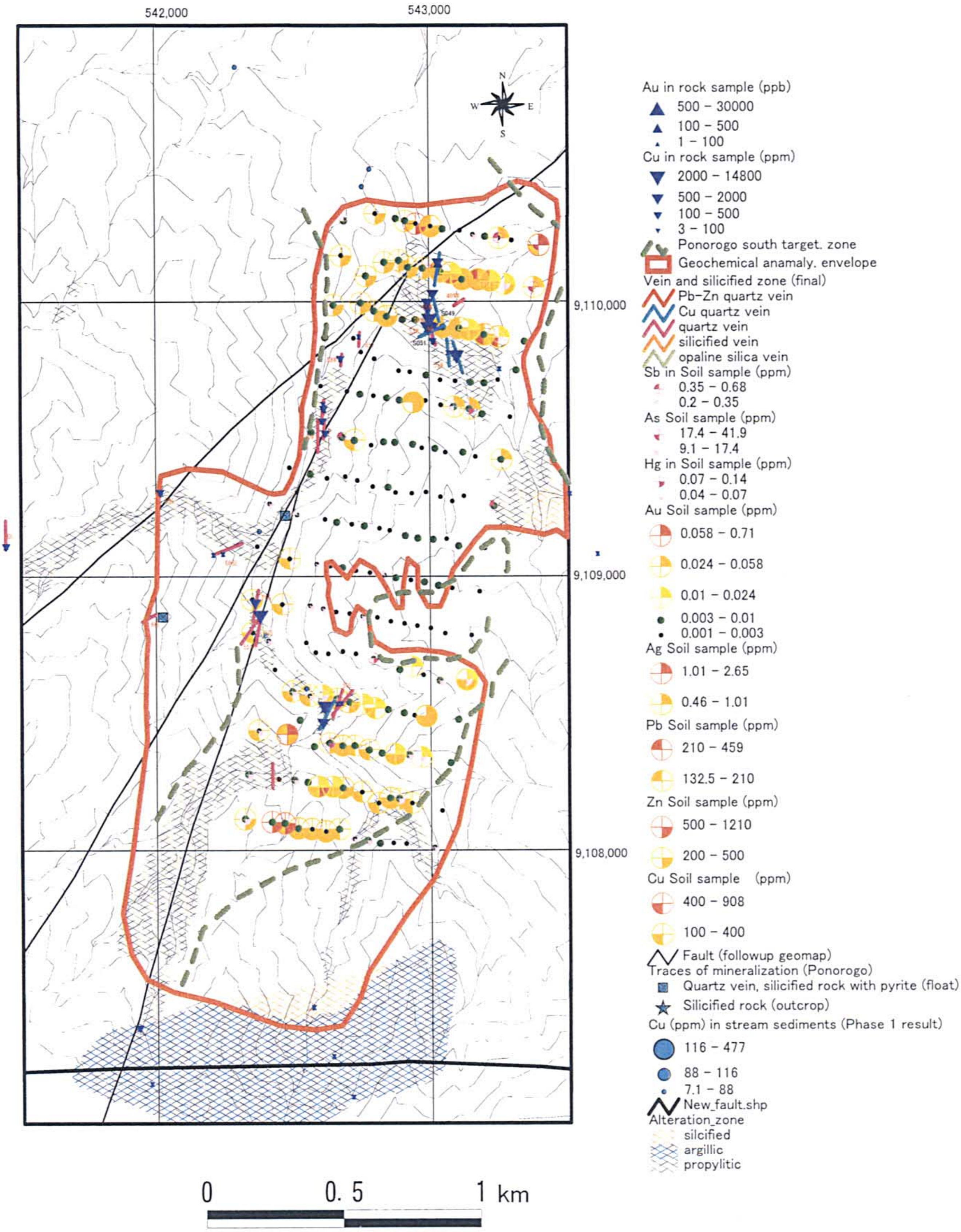


Fig. 5-13 Compilation Map of the Ponorogo South District (Nepo River Sub-district)

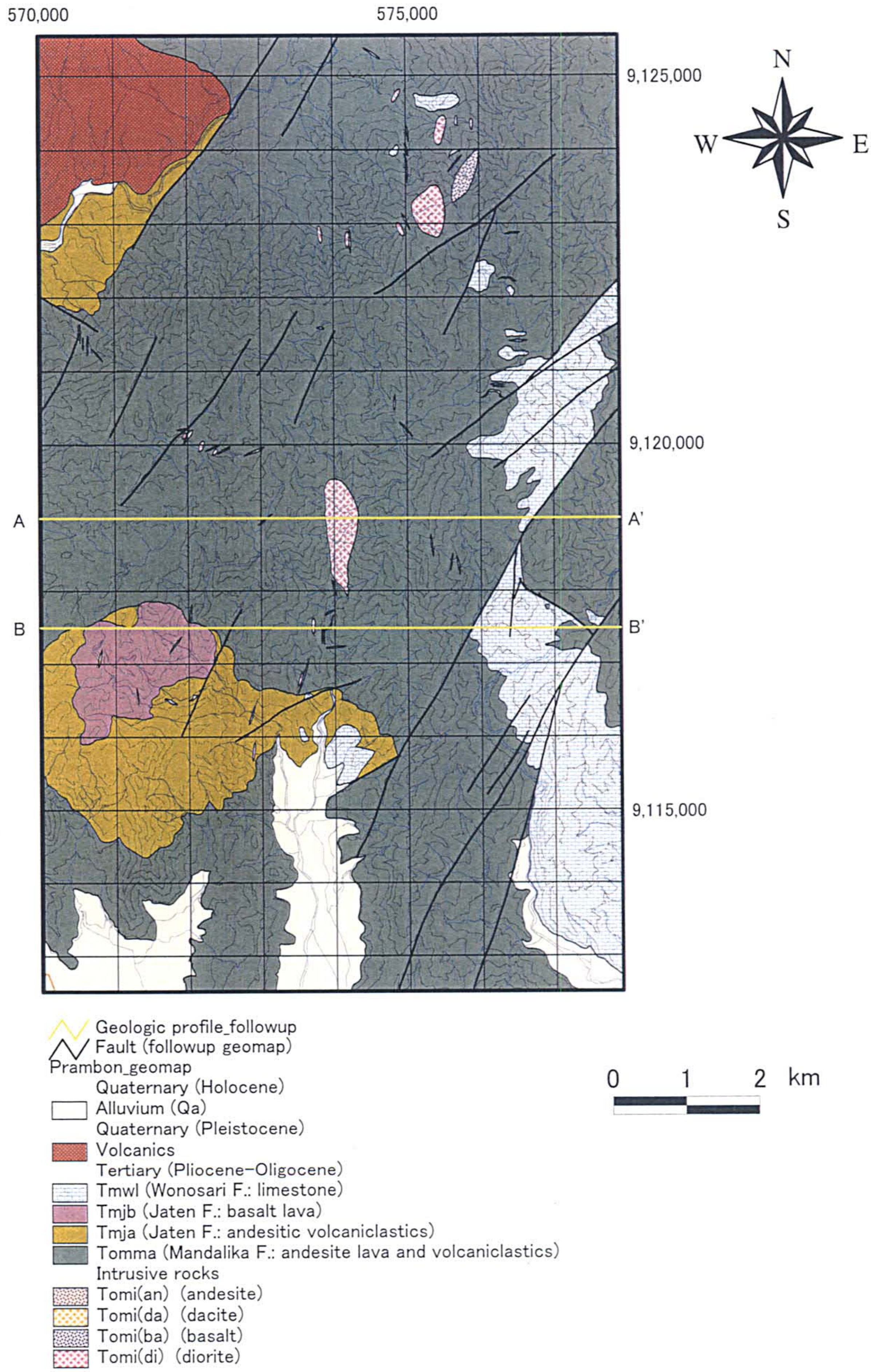
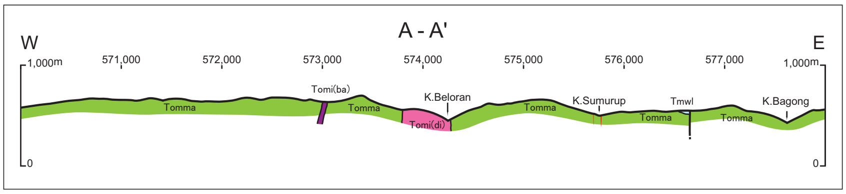


Fig. 5-14 Geologic Map of the Prambon District



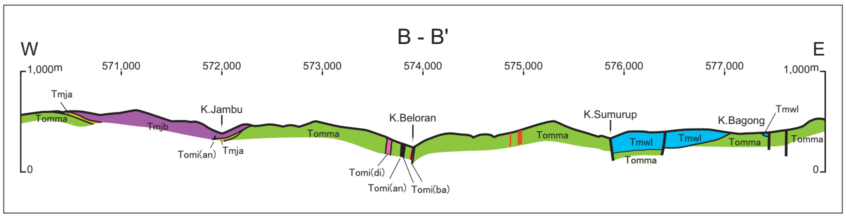


Fig. 5-15　Geologic Profiles of the Prambon District

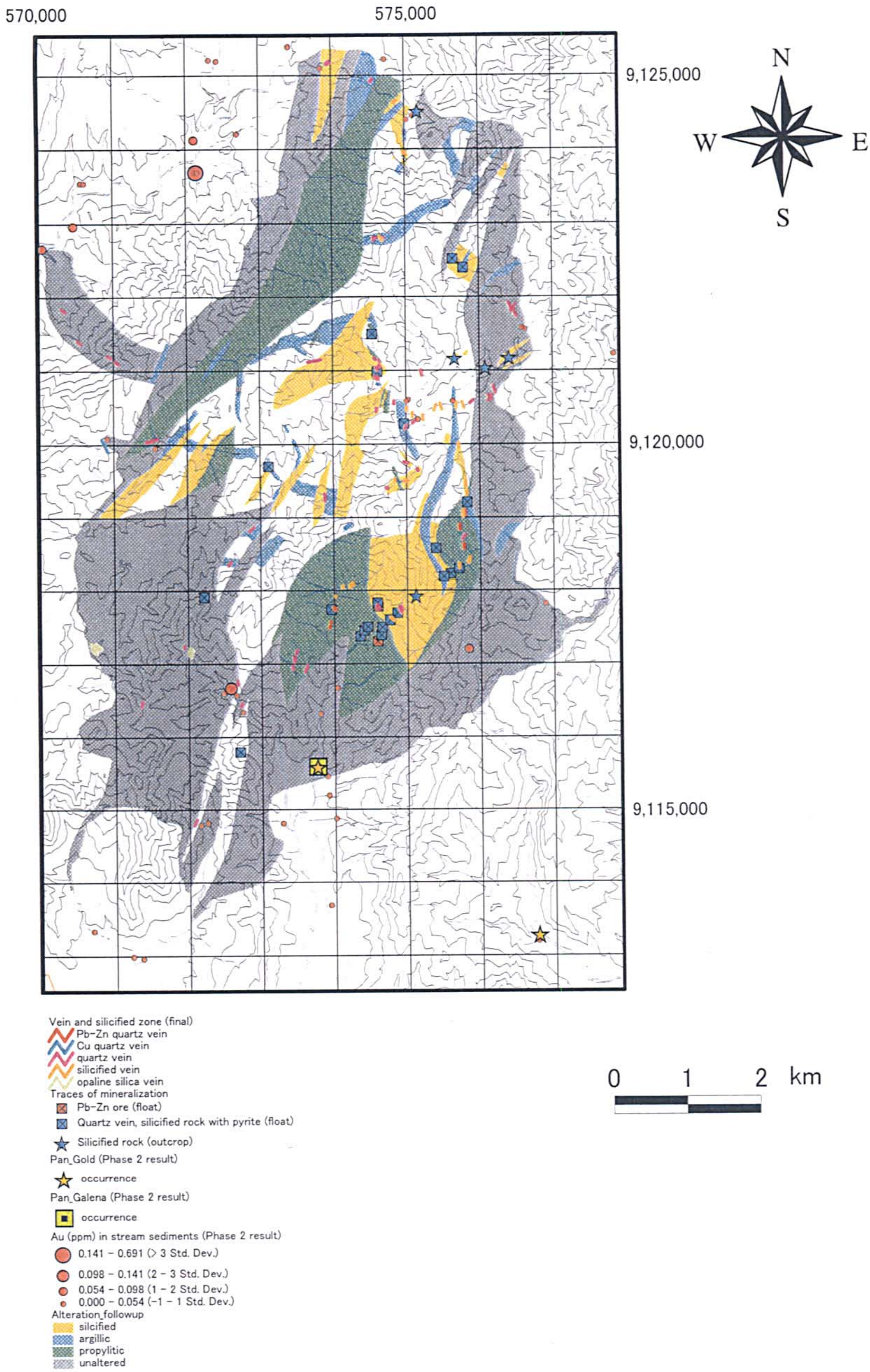


Fig. 5-16 Mineralized Zone of the Prambon District

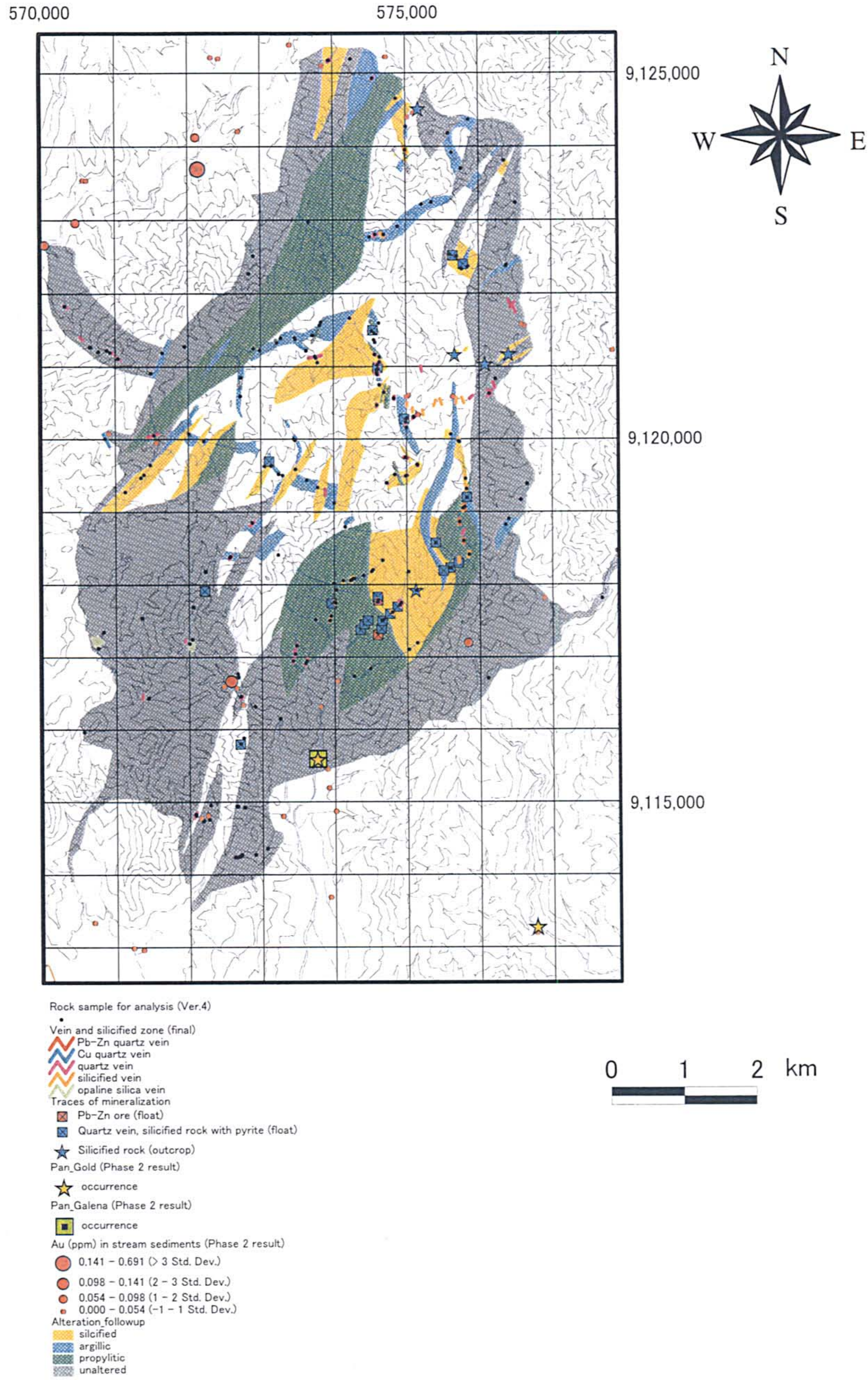


Fig. 5-17 Location Map of Rock Samples: Prambon District

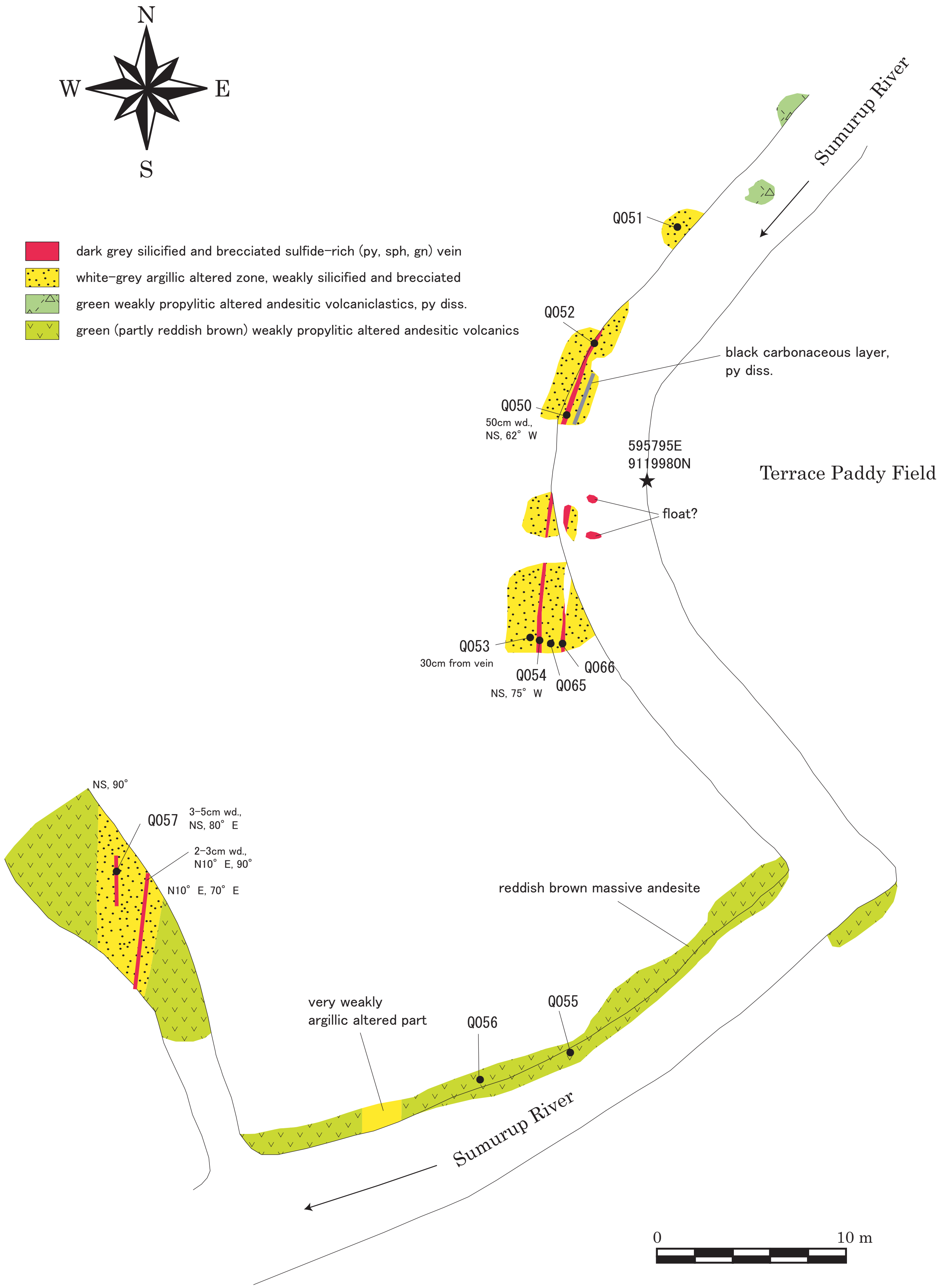


Fig. 5-18 Sketch of the Quartz Vein at the Upstream of the Sumurup River, Prambon District

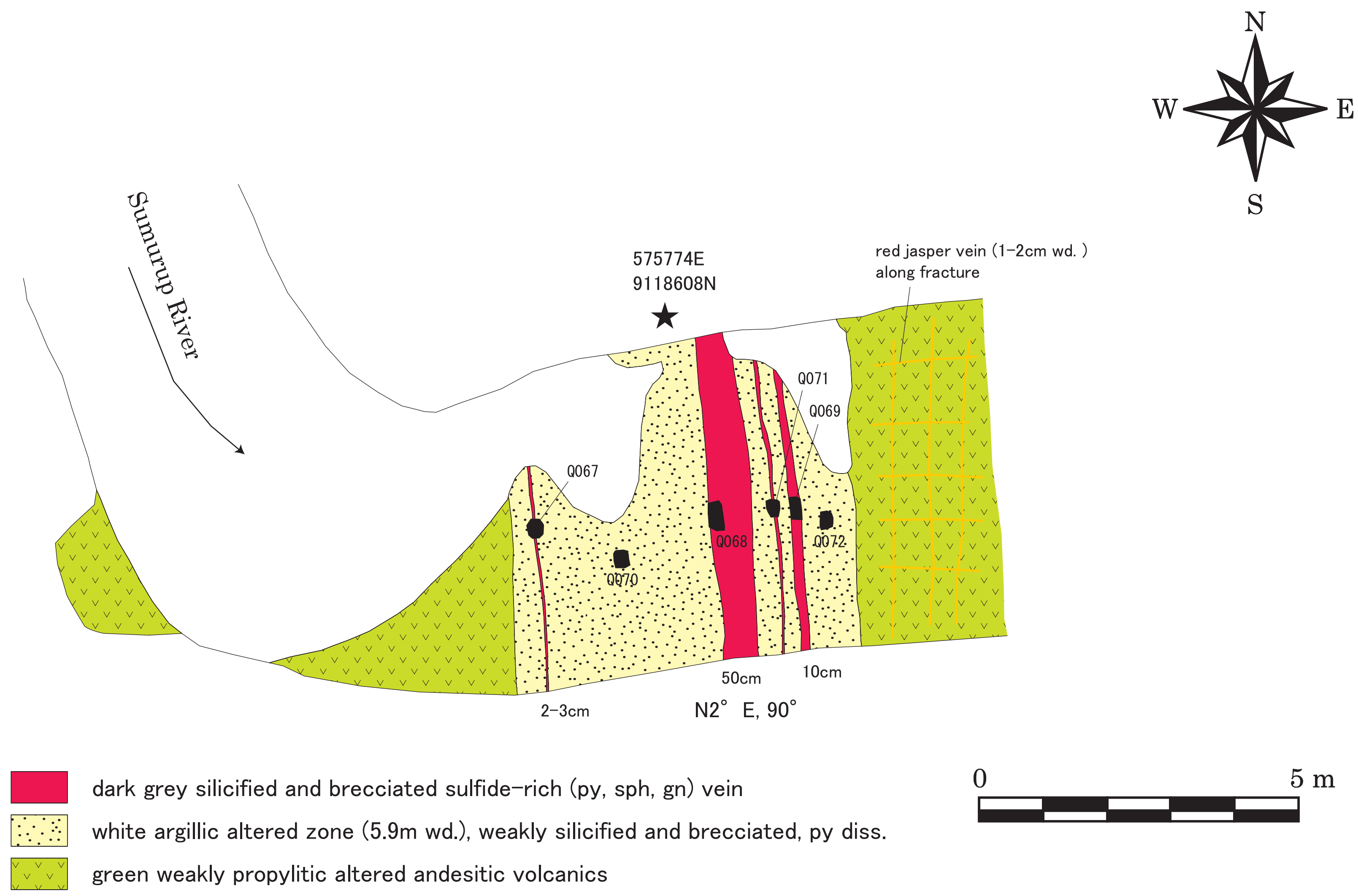


Fig. 5-19 Sketch of the Quartz Vein at the Downstream of the Sumurup River, Prambon District

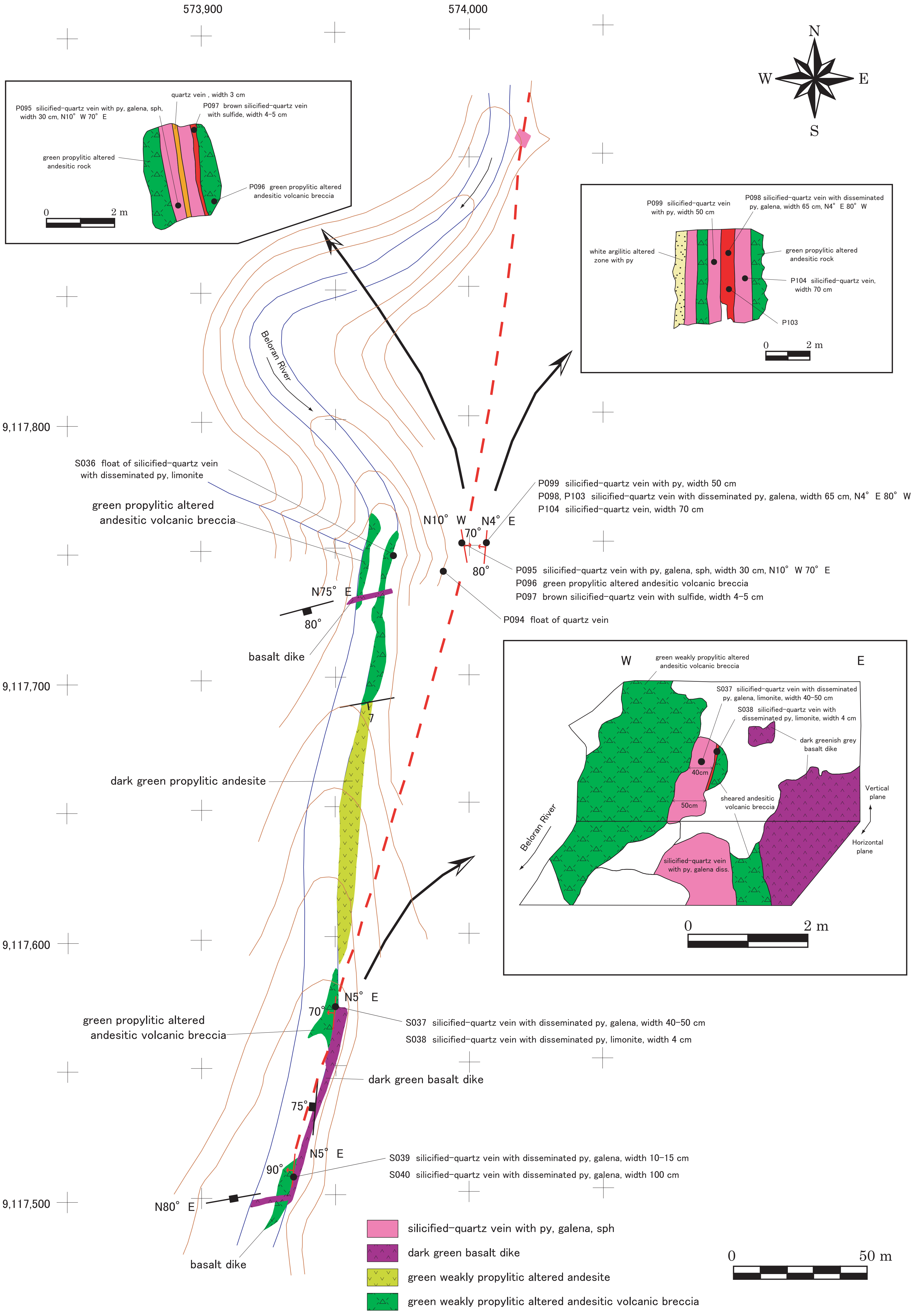


Fig. 5-20 Sketch of the Quartz Vein at the Beloran River, Prambon District

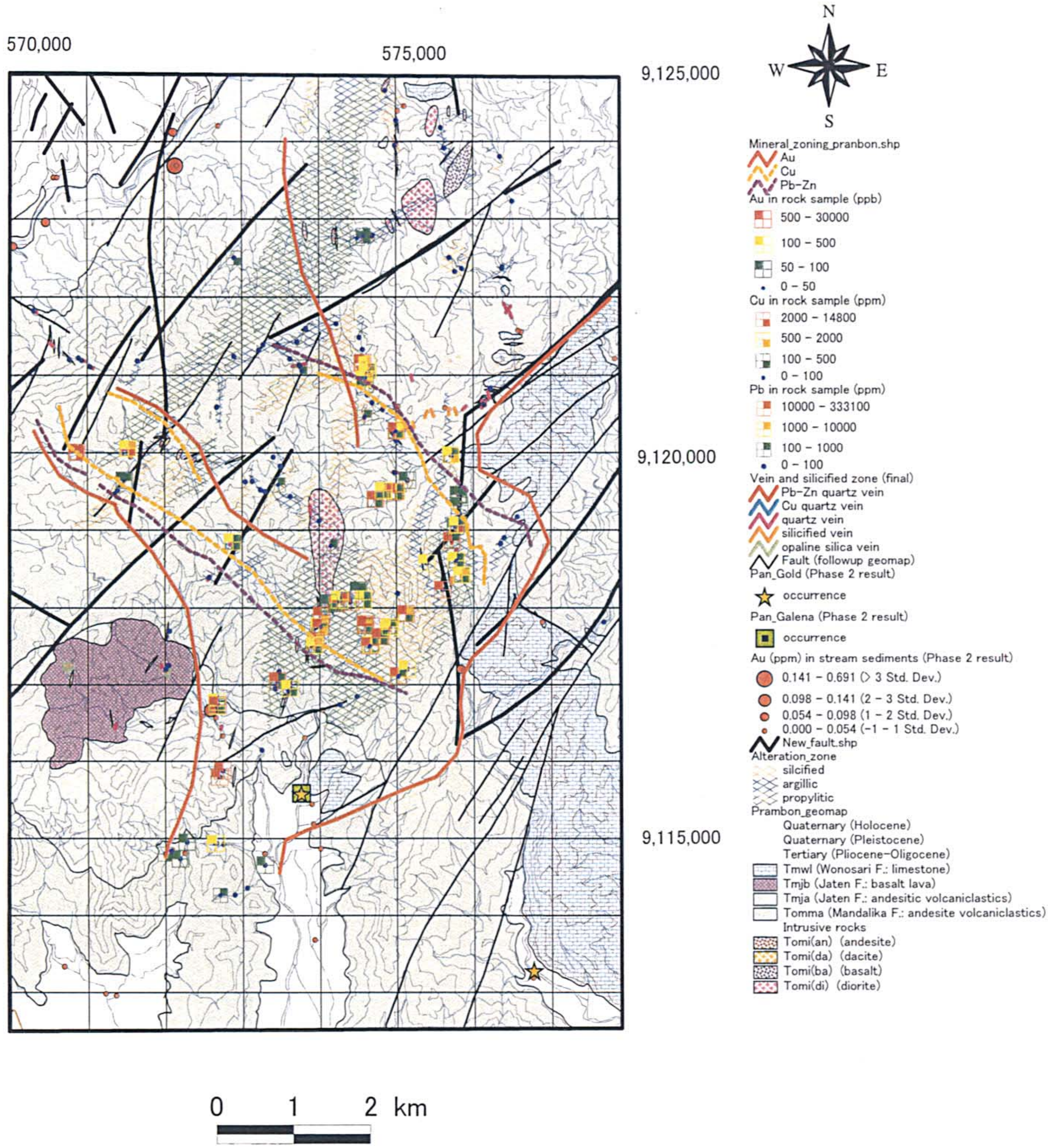


Fig. 5-21 Compilation Map of the Prambon District

PART III

CONCLUSIONS AND RECOMMENDATIONS

PART III CONCLUSIONS AND RECOMMENDATIONS

Chapter 1 Conclusions

Geochemical reconnaissance survey, geochemical semi-detailed survey, and geological survey was carried out during the second year of the East Java cooperative mineral exploration project, and arrived at the following conclusions.

1-1 Conclusions of the regional geochemical survey

The following are concluded to be the major mineralized zones.

(1) Selogiri district: Selogiri deposit in the eastern margin of the western area and auriferous quartz veins in the vicinity.

(2) Prambon district: Quartz veins (gold, silver anomalies) to the north of Trenggalek in the southwestern part of the eastern area of the district.

(3) Sentul district: Silicified zones to the southwest of Trenggalek.

(4) Seweden district: Alteration zones associated with gold, copper mineralization to the south of Blitar in the central part of eastern area of the district.

(5) Purwodadi district: Copper, gold mineralized and altered zones to the southeast of Malang.

(6) Tempursari district: Gold, copper mineralized and altered zones.

(7) K. Jinggring district: Gold anomalous zones to the south of Tulungagung in the western part of the eastern area.

(8) Seweden East district: Geochemical anomalies, quartz veinlets, alteration zones near the Royal Indotama Concession

(9) Purwoharjo district: Copper anomaly zone continuing northeastward from this district.

Of the above, surface mineralization is confirmed as well as geochemical anomalies in 6 districts from (1) to (6). Mineral potential is considered to be particularly high at the following 3 districts, namely in Selogiri district (1) mineralized alteration zones are distributed around presently working small mine, in Prambon district (2) gold mineralization, although of low grade, is found in epithermal quartz veins, and in Seweden district (4) alteration occurs widely and gold and copper mineralization occurs in quartz veinlets.

1-2 Conclusions of the semi-detailed geochemical survey

(1) Ponorogo south district: Au, Ag, Pb anomalies occur near wide developing silicified zone with pyrite dissemination to south of Ponorogo. The area may extend over the Slahung South anomalies zone identified by the Phase 1 regional survey.
(2) Lorok district: Au, Ag, As anomalies occur over the alteration area identified by phase 1 survey.
(3) Kasihan district: Cu, Pb, Zn anomalies occur near the Kasihan skarn deposit.
(4) Pacitan district: Ag, As, Mo anomalies occur to east of Pacitan. Micro-granodiorite intrudes into Oligocene-Miocene sediments and volcanics.
(5) Nawangan district: Cu, Pb, Zn and Mo occur over Oligocene-Miocene volcanics distributed area. Many quartz veins are exposed in this area. Quartz veins are accompanied by chalcopyrite, galena and sphalerite.
(6) Purwoharjo district: Au, Ag, As anomalies occur over the silicified zone identified during this survey. In this area, quartz veins also are exposed.

1-3 Conclusions of the geological survey

Deposits consisting mainly of copper-bearing quartz veins can be expected to occur in the Ponorogo South district. The past survey confirmed only one such quartz vein with 1~1.5 m thickness and 1~2km strike direction extension, but existence of quartz veins are anticipated in the silicified zones in the footwall side and/or northward extension of the Salak River.

In the Prambon district, lead-zinc-bearing quartz veins along the Sumurup River, the lead-zinc-bearing quartz veins along the Beloran River and the silicified veins (gold mineralization is inferred) near the summit of the mountain between the above two rivers, and further gold-copper-bearing quartz vein zone along the Suren River are believed to be most promising regarding metal potential.

1-4 Summary of conclusions

The mineral potential of the following six areas are considered to be particularly high.
(4) Geological survey area
  (a) Ponorogo South district; chalcopyrite-bearing quartz vein zone near the Nepo River.
  (b) Prambon district; gold-lead-zinc-bearing quartz vein zone along the Suren, Sumurup, Beloran Rivers.

(5) Semi-detailed geochemical survey area

Gold, copper and pathfinder element geochemical anomalies in semi-detailed geochemical area concentrate in the following six areas: tentatively named as Ponorogo South, Lorok, Kasihan, Pacitan, Nawangan and Purwoharjo district. Besides Ponorogo South district, four districts are promising:

(c) Lorok district

(d) Pacitan district

(e) Nawangan district

(f) Purwoharjo district.

(6) Regional geochemical survey area

(g) Vicinity of Selogiri gold deposit.

(h) Southern extension of the alteration zone near Seweden.

Of the above, (a) is located within the geological survey area, and (b) in semi-detailed geochemical survey area, but further detailed survey is necessary in (b) for planning drilling. Only regional geochemical survey has been carried out in (g) and (h), but the target of (g) is the gold-bearing quartz veins similar to known deposits. Regarding (h) the type of mineralization cannot be determined, but the gold and silver showings and the alteration zone is extensive, and thus extensive hydrothermal system perhaps exceeding that of (b) can be expected, and there are possibilities of the occurrence of large-scale gold-bearing quartz veins or porphyry copper deposits.

Chapter 2 Recommendations

2-1 Recommendations regarding geochemical reconnaissance area

It is recommended that geological survey be carried out in the following (1) and (3)~(6) districts on the basis of the conclusions regarding geochemical reconnaissance area, and it is also recommended that detailed geochemical survey of soil and rocks be carried out and drilling targets be extracted simultaneously. Then mineral potential of each district should be comparatively examined and drilling be carried out in the most promising zones. Where the high-potential targets are not confined only to veins and are extensive in area, it is recommended that IP electric survey (profile line length in the order of 10km) be carried out before drilling. (Geophysical survey: pyrite dissemination is expected to occur in mineralized zones expected in the area such as epithermal hydrothermal deposits and porphyry copper bodies, and IP electric is considered to be the best method to apply). Also scout survey should be carried out in the following (7)~(9) districts for understanding the cause of the geochemical anomalies in conjunction with semi-detailed geological survey. Geological survey of (2) district will be mentioned in 2-3.

(1) Selogiri district: Selogiri deposit in the eastern margin of the western area and auriferous quartz veins in the vicinity.
(2) Prambon district: Quartz veins (gold, silver anomalies) to the north of Trenggalek in the southwestern part of the eastern area of the district.
(3) Sentul district: Silicified zones to the southwest of Trenggalek.
(4) Seweden district: Alteration zones associated with gold, copper mineralization to the south of Blitar in the central part of eastern area of the district.
(5) Purwodadi district: Copper, gold mineralized and altered zones to the southeast of Malang.
(6) Tempursari district: Gold, copper mineralized and altered zones.
(7) K. Jinggring district: Gold anomalous zones to the south of Tulungagung in the western part of the eastern area.
(8) Geochemical anomalies, quartz veinlets, alteration zones near the Royal Indo Tama Concession
(9) Purwoharjo district: Copper anomaly zone continuing northeastward from this district.

2-2 Recommendations regarding semi-detailed geochemical survey area

Base on the result of semi-detailed geochemical survey, it is recommend that the following survey will be carried out as the next survey of the East Java mineral exploration project. It will be assesed the ore potential and extracted promising area for further drilling by detailed geological survey and soil geochemical survey.

(1) Ponorogo south district: Silicified zone and quartz vein zone in east side of semi-detailed area (around Slahung)

(2) Lorok district: Mineralized area around Lorok village and Lorok river

(3) Pacitan district: Intrusive distributed area in southern part of semi-detailed area

(4) Purwoharjo district: Silicified zone and quartz vein area in northwest part of semi-detailed area

2-3 Recommendations regarding geological survey area

It is recommended for the third year, that drilling be carried out in the Ponorogo South and Prambon districts which were delineated by the present survey.

(1) Ponorogo South district: Extension of the copper-bearing quartz vein along the Salak River is the target for drilling to be expected to occur in 1~2 km strike direction.

(2) Prambon district: Lead-zinc-bearing quartz veins along the Sumurup River, the lead-zinc-bearing quartz veins along the Beloran River and the silicified veins (gold mineralization is inferred) near the summit of the mountain between the above two rivers, and further gold-copper-bearing quartz vein zone along the Suren River are the most promising target for drilling.

2-4 Summary of recommendations

Prambon district (Suren River・Sumurup River~Beloran River zone) and Ponorogo South district (Nepo River zone) were extracted for drilling based on the results of geological survey carried out by the recommendations of geochemical reconnaissance and geochemical semi-detailed surveys carried out during this year. For Suren River・Sumurup River~Beloran River zone, however, the areal extent of the target should be clarified by soil geochemical survey before drilling.

Regarding Selogiri and Seweden districts extracted by geochemical reconnaissance (stream sediments), and Lorok, Pacitan, and Purwoharjo districts extracted by geochemical detailed survey (stream sediments), it is recommended that drilling targets be extracted by detailed geochemical survey (soil) or by geophysical survey and drilling be carried out.

If available time is restricted, the Nepo River district should be drilled first and drilling priority should be determined simultaneously by soil geochemical survey of Suren River・Sumurup River~Beloran River, geochemical survey of Selogiri, Lorok, Pacitan, and Purwoharjo districts and detailed survey of the Seweden district including geophysical survey.

The above recommendations are summarized as follows.

h) Ponorogo South district: drilling.
i) Prambon district: geological survey・soil geochemical survey → drilling.
j) Lorok district: geological survey・soil geochemical survey → drilling if warranted.
k) Pacitan district: geological survey・soil geochemical survey → drilling if warranted.
l) Purwoharjo district: geological survey・soil geochemical survey → drilling if warranted.
m) Selogiri district: geological survey・soil geochemical survey → drilling if warranted.
n) Seweden district: geological survey・geophysical survey → drilling if warranted.