



**COORDINATING COMMITTEE FOR GEOSCIENCE PROGRAMMES
IN EAST AND SOUTHEAST ASIA (CCOP)**

45th CCOP Annual Session

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Khon Kaen, Thailand

Member Country Report of Thailand

Submitted by

Thailand Delegation

(For Agenda Item 3)



**COORDINATING COMMITTEE FOR GEOSCIENCE PROGRAMMES
IN EAST AND SOUTHEAST ASIA (CCOP)**

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ANNUAL MEMBER COUNTRY REPORT

Country:	THAILAND	Period:	1 July 2007 – 30 June 2008
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GEO-RESOURCES SECTOR

1. MINERAL PROGRAMME

1.1 Summary

During the reporting period, the Department of Mineral Resources (DMR) carried out mineral exploration in 3 project areas outside the legally conserved/protected areas in northern Thailand. DMR also carried out 2 research projects concerning gemstone and basaltic rocks and mineral zoning.

1.2 Annual Review of Technical Programmes / Activities

1.2.1 Mineral exploration outside the legally conserved/protected areas

This project was established in 2007 and it will be completed in 2011. It was implemented by subcontracting private exploration companies under supervision of the Department of Mineral Resources. This project aims to intensively explore all over the country except the legally conserved/protected areas.

Project Summary

Duration : 8 December 2007 – 2 October 2008

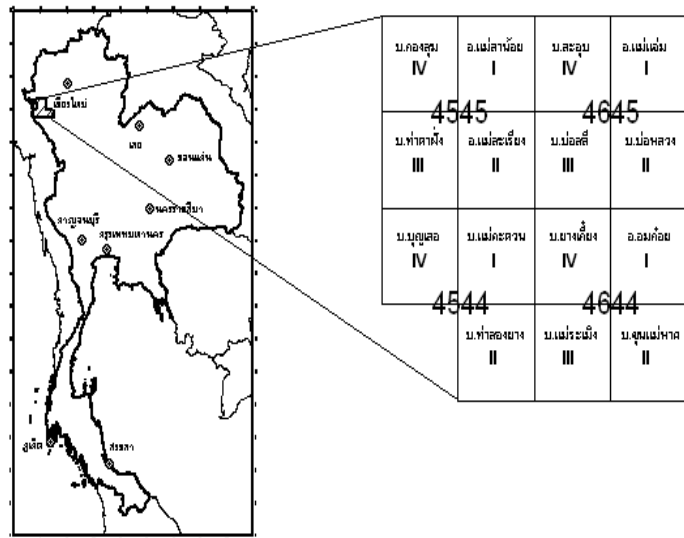
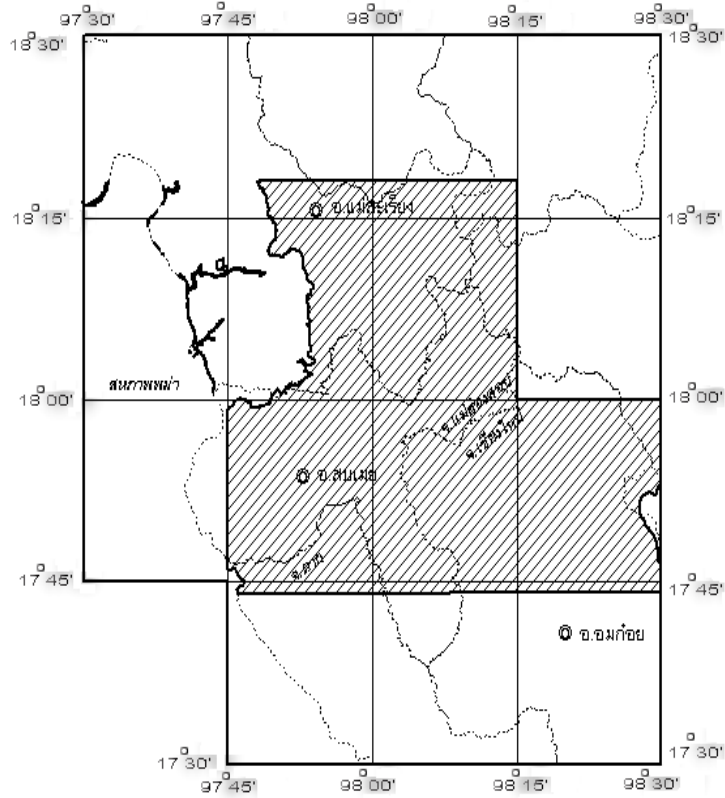
Objectives : Investigate mineral potential areas and mineral deposits for further development and for the country's integrated natural resources planning and management.

Project areas :

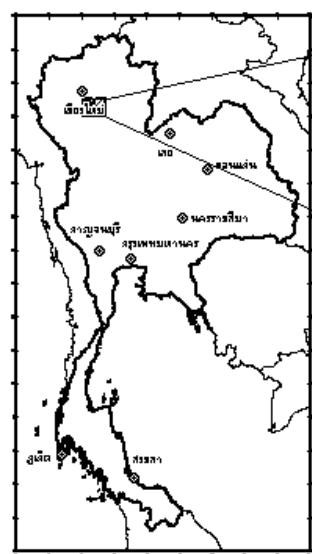
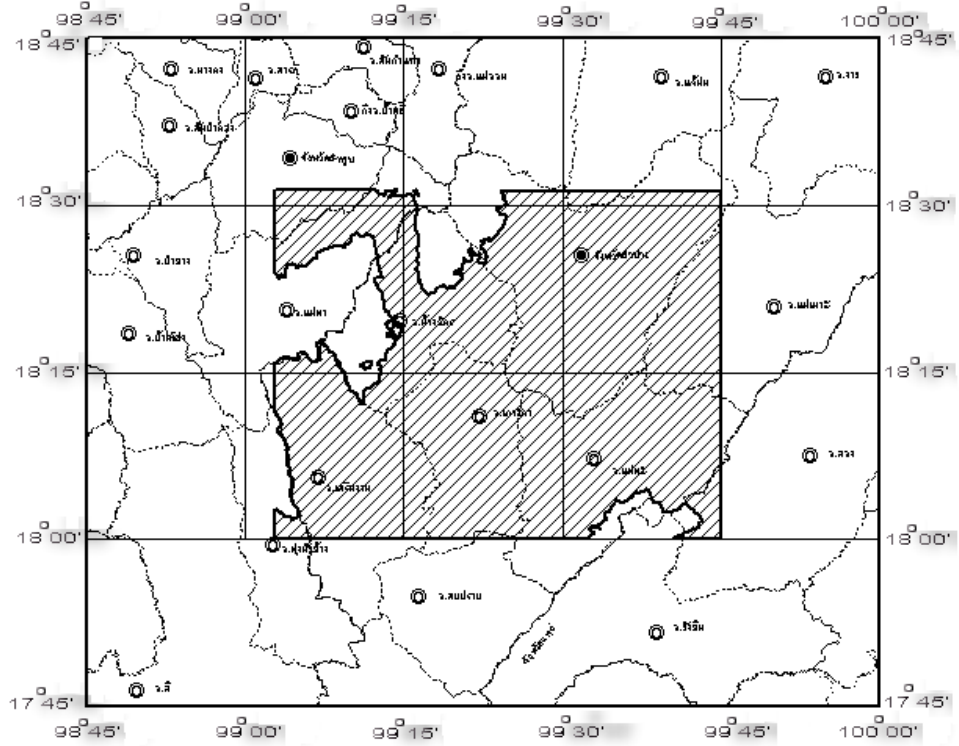
- 1) 1/2551 "Mae Sariang" (Mae Hongson, Chiang Mai and Tak Provinces),
3,600 sq.km.
- 2) 2/2551 "Hot" (Chiang Mai, Mae Hongson and Lamphun Provinces),
3,600 sq.km.
- 3) 3/2551 "Lampang" (Lampang, Lamphun and Phrae Provinces), 3,600 sq.km.

Progressive results : reported in September 2008 (150 days)
94% of project

Area 1/2551 “Mae Sariang”



Area 3/2551 “Lampang”



4746	4846	4946		
อ.สันป่าตอง II	อ.ลำพูน III	บ.ดอนชัย II	อ.เด่นหมื่น III	บ.ไผ่ II
อ.บ้านไผ่ I	อ.แม่ทา IV	อ.ห้างฉัตร I	อ.ลำปาง IV	บ.ทาสี I
4745	4845	4945	4945	4945
บ.ป่า II	อ.ทุ่งหัวช้าง III	อ.เกาะคา II	อ.แม่ทะ III	อ.สอง II
4744	4844	4944	4944	4944

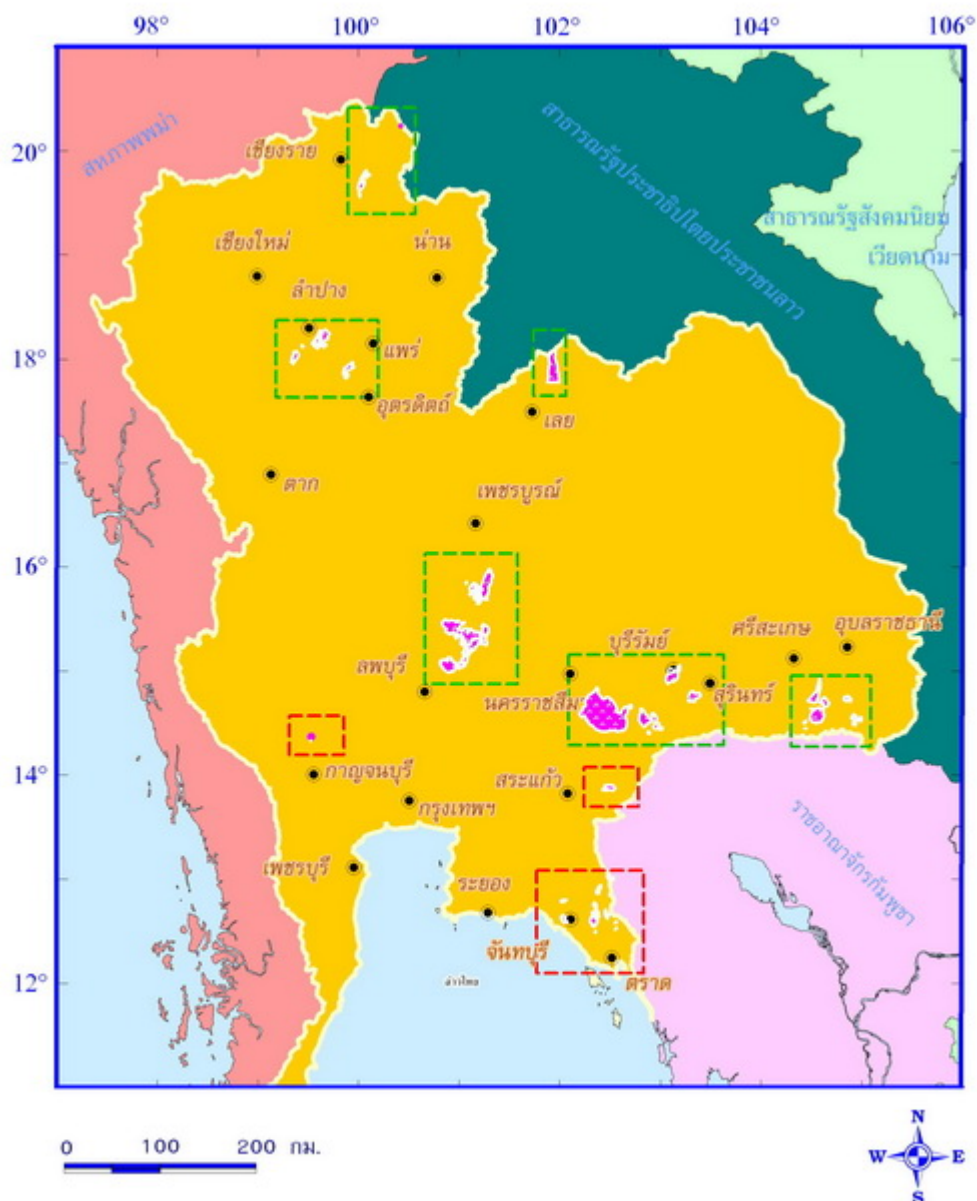
1.2.2 Scientific Researches

(1) Heat treatment of rubies and sapphires

The Department of Mineral Resources (DMR) has been conducting a research on heat treatment for quality enhancement of rubies and sapphires using samples from Madagascar and Tanzania (2008–2009).

(2) Application of basaltic rocks as a supplementary source of micronutrients for agricultural usages

The samples of 181 basaltic rocks were analyzed and evaluated for the data concerning plant nutrient sources. The result shows the great potential of plant nutrient sources in basaltic rocks. The available P, K, Ca, and Mg are as high as 1,500, 8,000, 8,000 and 3,800 ppm respectively. The research conclusion was distributed to the participants in Thailand Research Expo 2008. Future plan of this research is the experiment on basaltic rock dust application in soya bean bed.



1.2.3 Mineral Zoning and Geological Resources Management

Mineral resources development involve several stakeholders in the society. Systematic management of the mineral resources is needed in terms of effectiveness and fairness in the society. Participation is needed from relevant stakeholders. This project is a five year project, set up in 2006 to propose the management measures in each individual province for effective planning and management of its geological resources.

To begin, DMR compiles various data, information, maps at 1:50,000 scale of the geology, mineral potential and mining license areas, natural parks, forests, wildlife reserves, other restricted areas and land-use conditions, conservative geological sites, national and local economic situations.

Next step is to define the areas for potential development, considering the land-use conditions by laws and regulations. At this stage, the areas for mineral utilization have been divided into three groups namely,

(1) preserved areas (e.g., national parks, forest parks, wildlife sanctuaries, area of no animal-hunting, pollution control areas and mangrove preserved zones) : mineral resources in these areas will be preserved and are the last-priority for utilization,

(2) conserved areas (e.g., reformed land for agriculture, watershed areas class one, economic mangrove zone 1, forest zones restricted by laws, regulations, cabinet resolutions, mineral research survey areas designated by Mineral Act B.E. 1967, Section 6 bi) : mineral resources are planned to be used in the near future, or at present with certain conditions,

(3) development areas (e.g., economic mangrove zone 2, economic forest zones, industrial rock zones, mining license areas and mineral development areas designated by Mineral Act B.E. 1967, Section 6 quad) : mineral resources in these areas have no law, regulation or public restrictions for development. Prioritization of the development areas of each mineral commodity is considered by economic, social and environmental factors.

Finally, the preliminary reports would be sent to the relevant stakeholders for comments. A consultation meeting will be organized prior to submission of final report to the cabinet for approval. Executives and technical people as representatives of relevant agencies such as DMR, Department of Primary Industries and Mines, Office of Natural Resources Policy and Planning, Provincial Offices, Local Administrative Offices will be invited to join the consultation meeting.

In 2006 (October 2005 - September 2006), the work was carried out in eight provinces covering the Upper North region of Thailand namely Chiang Mai, Chiang Rai, Lampang, Lamphun, Mae Hong Son, Nan, Phayao and Phrae A few internal meetings in the DMR were organized in September 2006. In 2007 (October 2006 - September 2007), the work was carried out in ten selected provinces, namely Chumphon, Ranong, Surat Thani, Nakhon Si Thammarat, Phattalung and Trang in Southern Thailand, Nakhon Sawan, Saraburi and Lopburi in Central Thailand and Phichit in Northern Thailand.

In 2008 (October 2007 - September 2008), the work was carried out in ten selected provinces, namely Tak, Sukhothai, Uttaradit in Northern Thailand, Kanchanaburi, Uthaitхани and Prachinburi in Central Thailand, Rayong in Eastern Thailand, Rachaburi, Phetchaburi and Prachaub Kiri Khan in Southern Thailand.

This year, the work is planned to carry out in ten selected provinces namely Phetchabun, Phitsanulok in Northern Thailand, Loei, Kanlasin, Udonthani, Nong Khai, Nongbua Lampu, Khonkhean, Mahasarakham and Roi-Ed in northeastern Thailand. The mineral zoning is expected to cover the whole country by 2011.

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2. ENERGY PROGRAMME

2.1 Summary

Exploration activities included seismic surveys (2D and 3D) together with drilling activity both onshore and offshore. Dramatically elevated of crude price over the year 2006 – 2008 has been the major cause driving E&P to become more colorful. These has been proved by a significant success of the 19th petroleum concession bidding round together with the just passing 20th bidding round which was ended by May 2008. It was the most successful bidding as long as Thai's history since the first bidding round has been established up to present. This can be concluded by a figure of 52 blocks (44 onshore blocks whilst 8 offshore blocks) bidden from the total of 65 blocks with only 13 yet been engaged. It seems to be a great moment for the Thai Government that oil and gas businesses in the country are sparkingly. This can be confirmed by a numerous seismic surveys including drilling programme that took place in many areas in the country.

The amount of this year's crude oil production is not much different from last year. It was approximately 136,000 barrel per day that had been produced during July 2007 to end of June 2008 (5% increased). Natural gas production is also a little bit higher than last year at the same period, which was increased about 10.3%. Gas production rate was about 2,366 million standard cubic feet per day (mmcf) in 2007 changed to 2,600 mmcf in 2008. The majority of natural gas (94%) was produced from the Gulf of Thailand and the remaining was from 2 fields (100 mmcf) in the NE of Thailand and some of 40 mmcf from the Sirikit field. Condensate was produced at rate about 83,000 barrel per day which was 10.8% higher than last year. Production of crude oil from the onshore fields was brought up to 21% of the total crude production in the country; this was caused by the new discovery of the Na Sanun East Field in the Phetchabun Basin, central Thailand.

However, the total amount of petroleum production in the Kingdom can meet only 55% of the country demands which is clearly 5% higher than last year's indigenous supply. Coal is still being used as high as 32.55 million tons while the domestic coal can be supplied just only 14.31 million tons (44%). The total coal consumption in the Kingdom is relatively higher compared to last year (from 2.7% up to 7.85%), this may be the effect of the so high crude oil price since last year. The imported coal is currently as high as 14.31 million tons whilst 11 million tons was documented last year.

As the end of 2007, Thailand's preliminary proved reserves as announced by the Department of Mineral Fuels consisted of 11.19 trillion cubic feet (tcf) of natural gas, 265 million barrels (mmbbl) of condensate and 176 mmbbl of crude oil. As for probable reserves, these stood at 11.67 tcf, oil 201 mmbbl and condensate 322 mmbbl. As of the same date, possible reserves amounted to 6.84 tcf, condensate 140 mmbbl and oil 52 mmbbl.

2.2 Annual Review of Technical Programmes / Activities

2.2.1 Petroleum Concessions

By ending of the 20th Bidding Round in 22nd May 2008, there are totally 52 concession blocks have been bidden by several oil companies both giant and many of new face companies. There are 44 blocks located in onshore areas of Thailand, only 4 blocks in the offshore area in the Gulf of Thailand. Currently, 27 blocks have been awarded and 24 blocks have been under consideration processes. This can be said that it was a very successful era of the Thai Government since we have opened 20 bidding rounds. This can be confirmed by several blocks in the northern and northeastern Thailand which have never been taken interest by oil companies but in 2007 continued to 2008 seemed to be a big change (Figure 1 and Figure 2). It is no doubt that the world oil price as high as 140 bbl/us dollar is the major control together with very high demand from the giant consumers such as USA, India and China, also make the total demand of the world becomes extremely high.

2.2.2 New Petroleum Licensed Applications (PLA)

As the end of June 2008, 5 new production area applications (PAA) have been awarded. Three areas of these are located in the Gulf of Thailand whereas other 2 areas are located in the Phitsanulok and Phetchabun, central plain onshore basin.

2.2.3 Exploration and Production activities

For exploration, it was clearly much more activities for geophysical survey, particularly 2D seismic during the period of July 2007 to June 2008. Amount of 2D seismic was about 2,300 km in the last year whilst it was dramatically as high as 18,000 km this year at the same period. The large amount survey of 2D seismic was done by Pearl Oil over the large areas in the Gulf of Thailand, from north to south. The 3D seismic was conducted both onshore and offshore but almost equal amount compared to last year (737 line-km in 2006-2007 and 796 line-km in 2007-2008). Most 2D seismic surveys were conducted in the onshore areas by PTTEP Siam, Pan Orient and JSX.

There were 64 exploratory wells have been drilled during July 2006 to the end of June 2007. Thirty two wells were drilled in the onshore basins whereas other 32 wells drilled in the Gulf of Thailand. Development wells have been reported at 384 wells. In this amount, 52 wells were drilled in the onshore areas while 332 wells drilled in the Gulf of Thailand. The production of natural gas was about 2,600 million cubic feet a day (mmcf/d), while the condensate was about 83,000 barrel per day (bbl/d). The crude oil production was about 137,000 bbl/d. In terms of Crude Oil Equivalence, Thailand totally produced an average daily rate of about 666,000 barrels (approximately 39%) from the indigenous oil and gas fields and imported at about 1,015,000 barrels, which is approximately 55% of domestic consumption (Figure 3).

2.2.4 Coalbed Methane (CBM) and Oil Shale Projects

Department of Mineral Fuels (DMF) and Department of Energy Defense (DED) and Chiang Mai University carried out a study of gas adsorption and fracture system of the coal beds in the Fang Basin, Chiang Mai Province (belong to DED). The result of this study will be presented by the end of November 2008. Another co-project by DMF and Electricity Generating Authority of Thailand (EGAT) is the Oil Shale Project in Mae Sod basin, Tak Province. The project will be concluded by the end of 2008 in terms of feasibility study. Thirteen wells had been drilled for oil yield and the solid waste analysis. However, DMF will extend these studies to year 2009 with objectives to determine the reserves, quality and establish guideline for future development of oil shale and CBM in terms of alternative energy.

2.3 Proposed Future Activities and Assistance Required from CCOP in Support of Future Activities

- Training course or any short course involves with marginal field development. To understand various factors constituting marginal fields. It will be useful to Thailand to build up the experience, so that we can have own guidance to promote to be economical fields.
- Training or some short course on offshore petroleum decommissioning. To learn how to minimize the effects of decommissioning activities for the old fields that will be ending of production period soon.
- Training or some short course on petroleum field unitization. To learn the technique how to manage and operate the petroleum resources have been shared reservoirs and/or facilities effectively.
- Training or some short course on thin sand reservoir development. To gain new techniques that can be applied to multi-layered thin sand reservoirs.
- Training or some short course on carbonate reservoir where most fields in the northeastern Thailand are carbonate plays and still need to learn more to better understanding the reservoir properties.
- In house training on using GeoX on doing new prospect evaluation applied to the basin in Thailand and run economic analysis of field's potential.

2.4 Others

DMF involved with two CCOP activities; CDM in Vietnam and EPPM kick-off seminar in Bangkok as listed below.

- Eight staff participated in the EPPM Kick off Meeting, 6-9 Oct 2008 in Bangkok.
- Two staff from DMF participated the Training Course on CDM, held in Vietnam in May 2008.

There are two papers from DMF representatives submitted for this year's thematic session, namely,

- "Enterprise GIS in petroleum operation: helping to solve environmental problem" by Mrs.Orn-anutt Suthsa-ngiam, and
- "Potential gas utilization project from onshore oil fields in Thailand" by Dr.Witsarut Thungsuntonkhun.

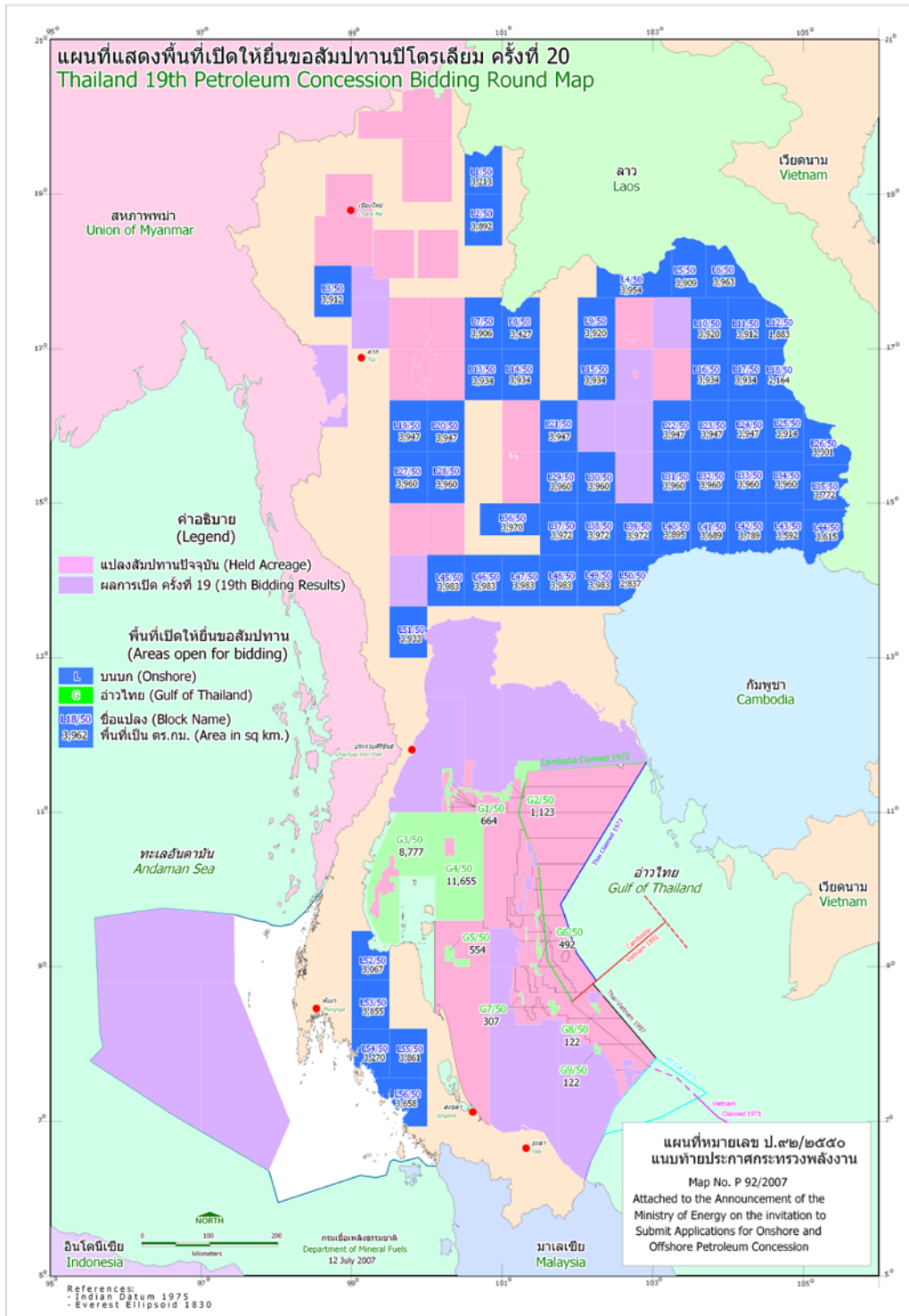


Figure 2. Map showing the blocks have been announced in the new 20th Petroleum Bidding Round (23rd May 2007 to 22nd May 2008).

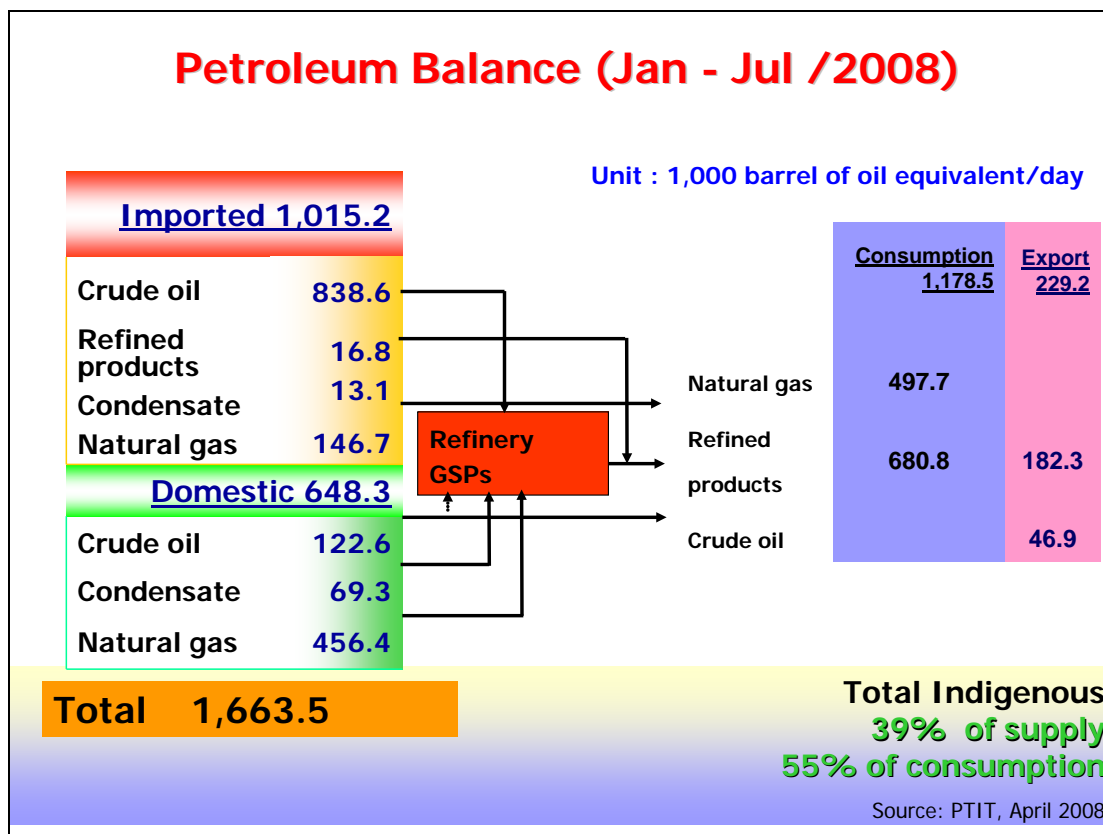


Figure 3. Petroleum balance of Thailand as of July 2008.

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3. GROUNDWATER PROGRAMME

3.1 Summary

Department of Groundwater Resources (DGR) takes part in two sub-group projects of “Groundwater Assessment and Control in CCOP Region” namely, (1) Groundwater and Land Subsidence Monitoring and (2) Groundwater Evaluation Using Monitoring System. Apart from CCOP groundwater projects, DGR conducted other important projects on groundwater resources protection programmes involving unused well plugging, well head protection from undulated flooding and well cleaning, construction of water treatment plants in the areas where people are facing high fluoride content in groundwater. Groundwater assessment including monitoring wells in Tha Chin and Mae Klong basins has been completed.

3.2 Annual Review of Technical Programmes / Activities

3.2.1 Groundwater and Land Subsidence Monitoring

The over pumping of groundwater in Bangkok and its vicinity has resulted in a decline of water levels and in the main aquifers. It causes the groundwater crisis and land subsidence. The monitoring data showed a clear correlation between land subsidence and the piezometric decline in the pumped aquifers.

Remedial measures have been implemented since 1983 to solve these problems. According to controlling of groundwater uses and collecting of groundwater fee and groundwater conservation fee in the critical areas results in the increasing of water levels and decreasing rate of land subsidence. At present, the most affected areas that undergo subsidence at the rate of 30 mm/year are the southeast and southwest suburbs. The most critical zone at the peak of the crisis 25 years ago was the eastern area of the city, which experienced the largest subsidence rate of 120 mm/year. But now the subsidence rate was decreased to only 20 mm/year. Impacts of land subsidence include increased flood risk, settlement problems of ground and buildings, coastal regression and seawater intrusion into aquifer layers, etc (Pienwej et al, 2006). The problems are particularly critical because of the flat low-lying topography of the city area and the presence of a thick soft clay layer underlying the ground surface. At present, a part of the eastern city area has sunk more than 1.0 m below the mean sea level. During rainfall, flood water needs to be drained by pumping through drainage canals and drain tunnels.

3.2.2 Fluoride Treatment

There are many provinces where groundwater resources are contain with high amount of fluoride, more than 1 mg./L. Some people who drink such kind of water for a long time have been seriously affected on their teeth and bones so called “Fluorosis disease” particularly in Chiang Mai and Lumphun Provinces. DGR has constructed groundwater treatment plants by installing reverses osmosis (RO) system and currently completed 280 stations through out the country. Actually fluoride sources are normally associated with granitic rocks or hydrothermal rising through fault zones

3.2.3 Groundwater monitoring system

Monitoring wells are very useful for evaluation of groundwater contamination. Changing of water levels or water qualities can be implied the status of groundwater resources. In sub-group project with CCOP, KIGAM (leader of sub-group in Groundwater Evaluation Using Monitoring System) recommended and gave the way to create network of monitoring system by scientific method. Currently, DGR have a total of 1,662 monitoring wells through out the country. In this year, Mae Klong and Tha Chin basins were selected for additional monitoring wells construction with a total of 37 stations and 986 monitoring wells. These new networks will be useful for groundwater management both in these basins and Lower Chao Phraya basin.

3.2.4 Groundwater Assessment

Groundwater potentials are very important in terms of water management. Sustainable development is promoted in the worldwide especially the topic of water resources. DGR has intended to evaluate groundwater potentials in every significant basin. Currently, the main basins consisting of unconsolidated rocks are regionally evaluated-

Chiang Mai basin, Upper Chao Phraya basin, Lower Chao Phraya basin, Mae Klong basin and Hat Yai basin. In 2008, DGR has worked in Tha Chin and Mae Klong basins by using mathematical model and concluded that groundwater can be exploited safely as much as approximately 600 million cubic meter per year

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GEO-ENVIRONMENT SECTOR

1. COASTAL ZONE PROGRAMME

1.1 Summary

Coastal erosion in Thailand exists in several locations on coastlines both coastlines in the Gulf of Thailand and Andaman. Nowadays, it is found that coastal erosion occurs widespread along Thai's coastlines and more likely severe in some localities. Therefore coastal erosion was raised up to be national agenda for disaster reduction plan in 2008. Department of Mineral Resources (DMR) as the government agency of Thailand responsible for geological hazard management and geological survey has conducted survey and study on the physical change of coastlines to evaluate the geological factors in conjunction with meteorological and oceanographical factors which cause the coastal change.

Additionally, the studies on other geohazards which will affect the coastal area are considered as a part of coastal management. The information from the study will principally be used as the database for sustainable coastal management. For further understanding coastal process, the factors inducing coastal change and coastal erosion impacts must be taken into consideration. Inevitably, these are 2 functions needed for assessment including,

- Development of coastal change database.
- Supporting the coastal change assessments with knowledge of geology, geotechnics, oceanography, meteorology, coastal engineering and others relevant knowledges.

1.2 Annual Review of Technical Programmes / Activities

The progress of DMR activities in response to coastal management can be summarized as follows:

1.2.1 The coastal change along Andaman sea coast and the Gulf of Thailand : The study on the coastal change of Thailand is a project conducted by Environmental Geology Division of the Department of Mineral Resources. The overall goals are to investigate and identify areas undergoing coastal erosion, to evaluate the causes and degree of coastal erosion and provide a "Coastal change database" that is much useful to proper coastal zone

management based on geological data. The detail study in severe erosion area as Phetchaburi Province, Songkhla Province and Nakhon Si Thammarat Province were conducted from October 2007 to October 2008. The monitoring of coastal changes was carried out through the comparative analysis of the past-shoreline and the present-shoreline based on satellite image and field survey data. The beach profiles were also obtained in severely eroded areas for a short-time interval in order to show relationship among seasonal changes, coastal morphology and causative factors.

In addition, the integrated knowledge for shoreline protection project by using the designed artificial reef which functions as submerged breakwater to attenuate the incident wave energy was conducted in collaboration with Prince of Songkhla University in the pilot area located at Kao Seng beach, Songkhla Province. The individual reef unit was designed properly for both its shape for enhancement of the marine habitat ecology, and its mass for bearing the wave forces. The alignment of submerged reefs was designed to absorb predominant storm wave and to reduce the impact to longshore sediment transport. Since crest of the reef is lower than the lowest tide, so there is no impact to aesthetic view of the recreation beach and the construction cost is also much cheaper than that of offshore breakwater. The use of designed artificial reef would be a highly feasible alternative for shore protection in Thailand.

1.2.2 Tsunami hazard studies: DMR has been studying the tsunami hazard since the 26th December 2004 tsunami event with support and cooperation of various countries and international organizations. In February 2008, a survey team of DMR and Adam Mickiewicz University at Poznan, Poland carried out a field work related to the tsunami hazards focusing in paleo-tsunami study and its existing geological and environmental impacts in Phang Nga and Phuket. DMR also carried out further investigation in March 2008.

1.3 Proposed Future Activities and Assistance Required from CCOP in Support of Future Activities

On the basis of present information, the coastal changes are caused by both natural processes and human activities. The reduction of coastal sediment budget related to upstream damming, coastal land subsidence resulted from groundwater pumping, development and changing of land-use, the influence of the movement of tidal current and long shore current, and the increasing in frequency and degree of storm as well as sea level rise are the factors related to coastal erosion on the coastline of Thailand. Due to insufficient geological, oceanographical and meteorological data as well as land-use change pattern, and coastline development project, therefore, the research for coastal erosion protection cannot obtain much reliable results for designing appropriate protection structure and policy for coastal zone management. However for short period of data collection, the results of the study do not clearly know how those factors would influence to the coastal change process. The assessment with the support of geological study, coastal engineering study and other techniques are necessary i.e. developing and applying relatively simple coastal erosion models, developing predictive models for assessing impacts of the related coastal erosion factors, and long-term coastal monitoring measurement. Then the reliable assessment and sustainable mitigation plan can be obtained.

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2. GEO-HAZARDS PROGRAMME

2.1 Summary

Generally in the past it has been believed that Thailand locates in low seismicity area, no earthquake effect to the people. Severe seismic intensity caused by major earthquake have never occurred inside Thai territory areas except one events in history was recording that describing the collapse of a town in the northern part by a big earthquake more than thousand years ago. By the time passed, many important events that panicked to people have been forgotten. However, in the past 3 decades several moderate earthquakes occurred more frequently and caused a great panic to the public with slight to moderate damages to the vulnerable development, create enormous construction with crowded community are expanded into seismic risk zones. Some locations of moderate earthquakes that have never harmed to people in the past record initially cause some damage to vulnerable construction.

Additionally, geohazards such as landslide mudslide flash flood and etc. occur in many provinces of Thailand and seem to cause more and more damage both in properties and people life. Department of Mineral Resources (DMR) as the government agency of Thailand responsible for geological hazard management has selected the prototype areas for the sustainable rehabilitation including 2 areas in Changwat Uttaradit and 1 area in Changwat Chiang Mai. The mains activities compose of detailed geological mapping in the scale of 1:4,000, adjusting the existing streams and establishing rehabilitation planning with along with the locals.

2.2 Annual Review of Technical Programmes / Activities

2.2.1 Active fault study

The major goal of DMR's study by Environmental Geology Division in 2007 is to delineate the characteristics of the Ranong and Khlong Marui Faults and to define the mean for earthquake mitigation on several communities affected by these two fault groups passing the study areas by the generation of new active fault maps. The area under investigation covers several district areas where Ranong and Khlong Marui Faults pass including those of Prachaub Khiri Khan, Chumporn, Ranong, Surat Thani, Krabi, Phangnga and Phuket Provinces.

Based upon the results on earthquake geology along the faults from this survey, summary is made in the following aspects as:

(1) Results on geological, geomorphological and geophysical data reveal that both Ranong and Khlong Marui Faults show evidence of movements during Quaternary Period. The Ranong fault can be subdivided into 16 fault segments whereas the Khlong Marui Fault can be divided into 10 segments. Based on age dating data, Ranong segment of the Ranong Fault, Bang Khram and Tup Butr segments of the Khlong Marui Fault are regarded as active faults;

(2) Ranong fault segment, which strikes in the northeast – southwest direction and dips in the northwest direction, shows the left lateral sense of movement at present. The surface rupture length of about 50 km is estimated to yield the maximum paleoearthquake of about 7.2 on the Richter scale;

(3) Tup Butr fault segment, which has the strike in the northeast – southwest direction and the dip to the northwest direction, indicates the left lateral sense of movement. The surface rupture length of about 50 km was determined to yield the maximum paleoearthquake of about 7.2;

(4) Bang Kram fault segment has the strike in northeast – southwest direction with dipping northwest, and show left lateral sense of movement. The estimated surface fault length of about 16 km produced a paleoearthquake magnitude of about 6.4; and

(5) Both Ranong and Khlong Marui Faults are regarded as active and have the late movement at about 9,000 and 1,200 years ago, respectively.

2.2.2 Landslide investigation : Warning network

Explosive population growth and economic development have expanded the range of water-related problems, such as shortages of supply and pollution. Moreover, natural disasters related to water, like landslide and flash flood also causes suffering to people. A landslide is a geological phenomenon which includes a wide range of ground movement, such as rock falls, deep failure of slopes and shallow debris flows. Although gravity acting and an over steepened slope is the primary reason for a landslide, there are other contributing factors affecting the original slope stability by rainfall.

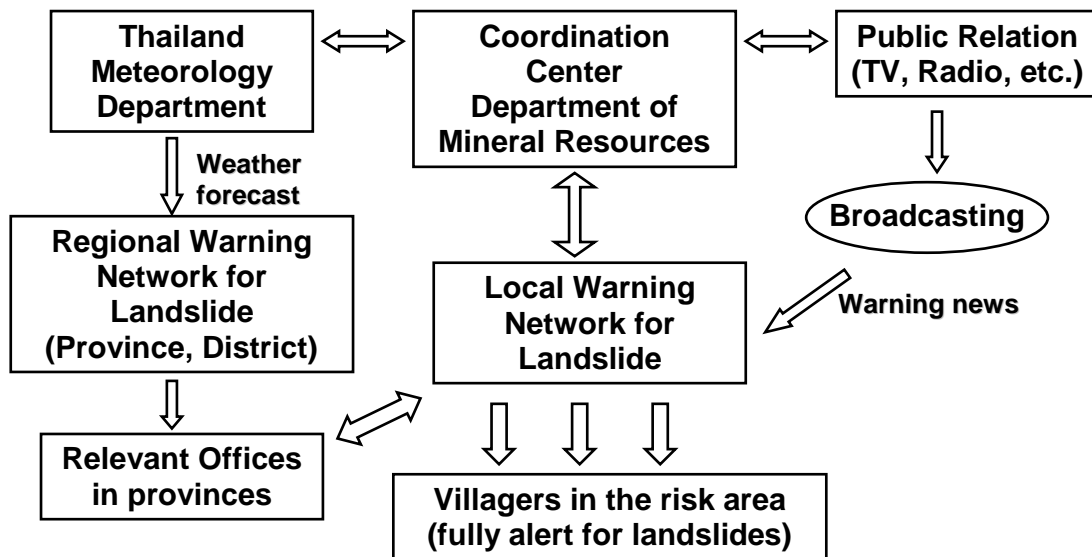
Geological investigation were conducted in landslide hazard our areas to collect geological data and assess damaged and vulnerable areas. The computerized technique with an assistance of GIS and remote sensing was used for analyzing and modeling to delineate, categorize susceptible areas and define landslide risk villages. Persuasion people living in the risk area to be volunteer groups for disaster caution holding a workshop for training and hearing of their opinions on landslide matter to point out risk potentials, to encourage people in disaster preparedness, to boost up awareness and to get better understanding of landslide behavior, warning sign and evacuation.

In 2008, DMR's volunteer warning networks on Satun, Lamphun, Loei, Ratchaburi, and Phetchaburi Provinces are 335, 475, 970, 201, and 254 people, respectively.

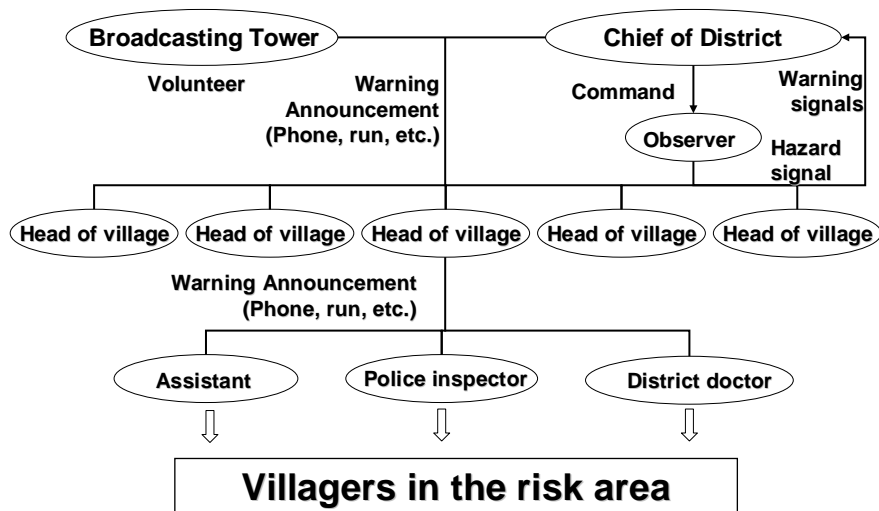
Landslide mitigation:

- Training people in risk villages on “Early Warning Networks for Landslide”
- Searching for volunteers to participate in early warning networks
- Participating in survey and selection of appropriate observatory sites,
- Advising to group discussion to define plan and method of dispatching warning messages.

Coordinating diagram in the landslide warning network



Landslide Warning Network



2.2.3 Surveying and rehabilitation planning for geohazards

Surveying and rehabilitation planning for geohazards of DMR were conducted by the Geotechnic Division and can be concluded as follows:

1. *Baan Nam Ta, Tambol Nam Man, Amphoe Tha Pla, Changwat Uttaladit*: Detailed geological mapping in the scale of 1:4,000, geophysical study and sedimentary profile study along the streams were carried out covering the area of two square kilometers. Flow pattern of the existing streams have been adjusted into the U-shape for better flow. The landslide barriers have been built in the potential areas. Furthermore, the rehabilitation plan for this area has been established with the cooperation between DMR and the local people.

2. *Baan Dan Huai Tai, Tambol Mae Plu, Amphoe Lab Lae, Changwat Uttaladit:* Detailed geological mapping in the scale of 1:4,000, geophysical study and sedimentary profile study along the streams were carried out covering the area of one square kilometer. Flow pattern of the existing streams have been adjusted into the U-shape for better flow. The landslide barriers have been built in the potential areas. Furthermore, the rehabilitation plan for this area has been established with the cooperation between DMR and the local people.

3. *Mae Ngon Royal Project area, Changwat Chiang Mai:* This area was influenced from the flash flood and landslide. In the initial stage, the geohazard risk mapping at scale 1:50,000 was carried out. The further detailed geological mapping and remote sensing mapping such as SPOT satellite data and aerial photograph of the area at scale 1:10,000 were analyzed for more accuracy.

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3. ENVIRONMENTAL GEOLOGY PROGRAMME

3.1 Summary

The Department of Mineral Resources (DMR) carried out an experimental baseline geochemical study in an effort to outline natural contaminated areas of hazardous elements such as arsenic, copper, manganese, lead, zinc, cadmium, and others in Chiang Rai Province, covering study areas approximately 10,000 square kilometres.

3.2 Annual Review of Technical Programmes / Activities

The Department of Mineral Resources (DMR) has an experimental baseline geochemical study in an effort to outline natural contaminated areas of hazardous elements such as arsenic, copper, manganese, lead, zinc, cadmium, and others, covering study areas approximately 10,000 square kilometres in Chiang Rai Province, has been selected for this case study, base on geological and geographical conditions.

The technical activities include collecting 697 surface water samples, 367 residual soil samples and 697 stream sediment samples covering the whole study area, and analysis with Inductively Coupled Plasma - Optical Emission Spectrometer (ICP-OES) tool, except surface

water sample analysis for arsenic which used the Graphite Furnace Atomic Absorption Spectrometer tool.

Level of risk in the contaminated area are determined into 3 levels that are 1 – 2 – 3 (low - medium – high risk). Natural contaminated areas of hazardous elements in Chiang Rai are concluded as follows :

Arsenic : high level was observed in 32 areas (400 square kilometres) and medium level in 4 areas (44 square kilometres) from stream sediments and surface water data, high level in 33 areas (1,213 square kilometres), medium level in 17 areas (8 square kilometres) and low level in 9 areas (8 square kilometres) from residual soil data.

Copper : high level was observed in 20 areas (331 square kilometres) from stream sediment and surface water data, and high level in 7 areas (682 square kilometres) from residual soil data.

Manganese : high level was observed in 13 areas (204 square kilometres) from stream sediments and surface water data.

Lead : high level was observed in 1 area (14 square kilometres).

Zinc : high level was observed in 17 areas (229 square kilometres) from stream sediments and surface water data, high level in 1 area (270 square kilometres) from residual soil data.

Hazardous elements distribution map in stream sediments, surface water and residual soil in Chiang Rai Province (Figure 1-8) will be useful for distribution to related sectors, general public and people in this area.

3.3 Proposed Future Activities and Assistance Required from CCOP in Support of Future Activities

Fellowships for study tour in other countries that have similar programme.

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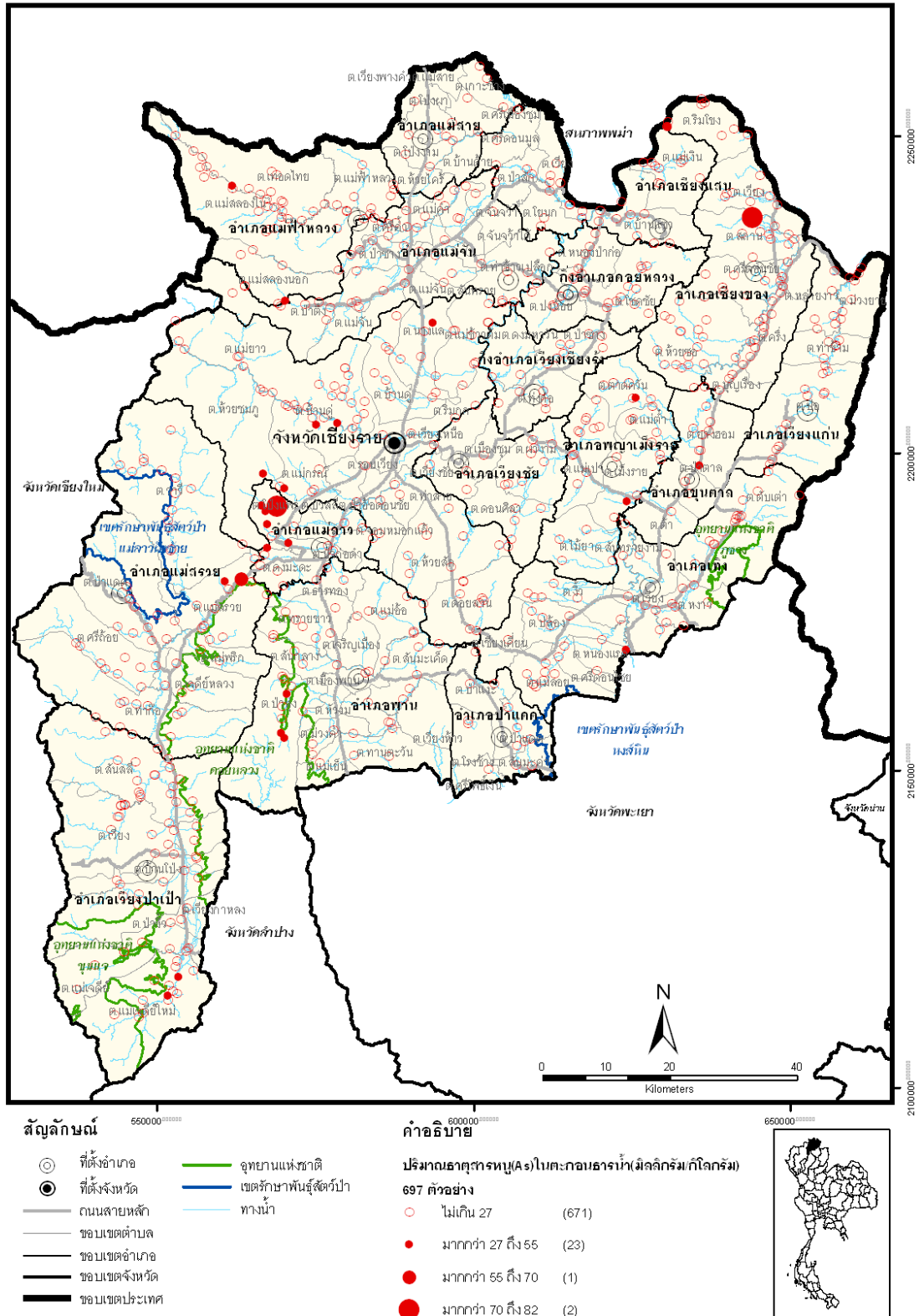


Figure 1. Arsenic distribution in stream sediments, Chiang Rai Province.

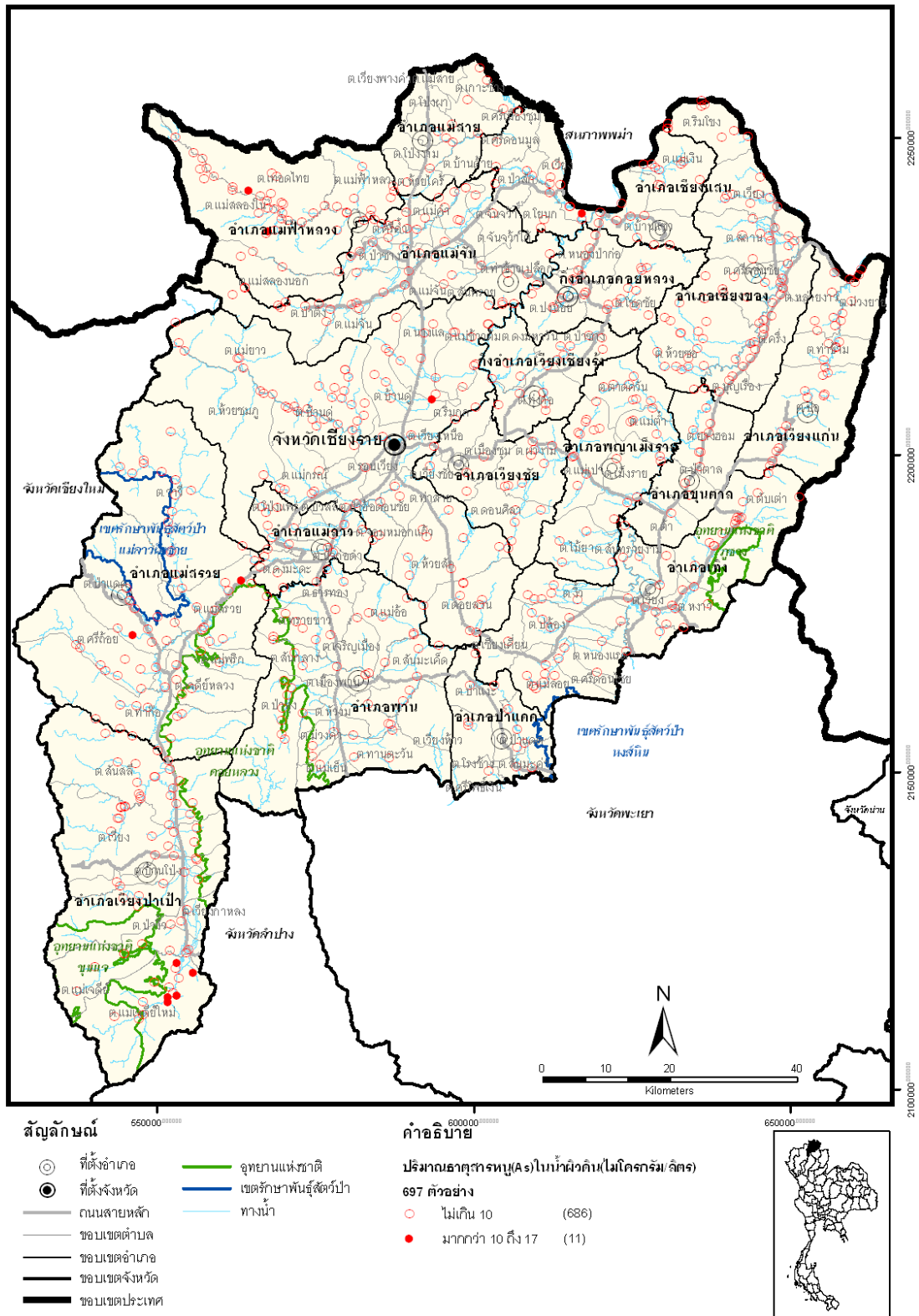


Figure 2. Arsenic distribution in surface water, Chiang Rai Province.

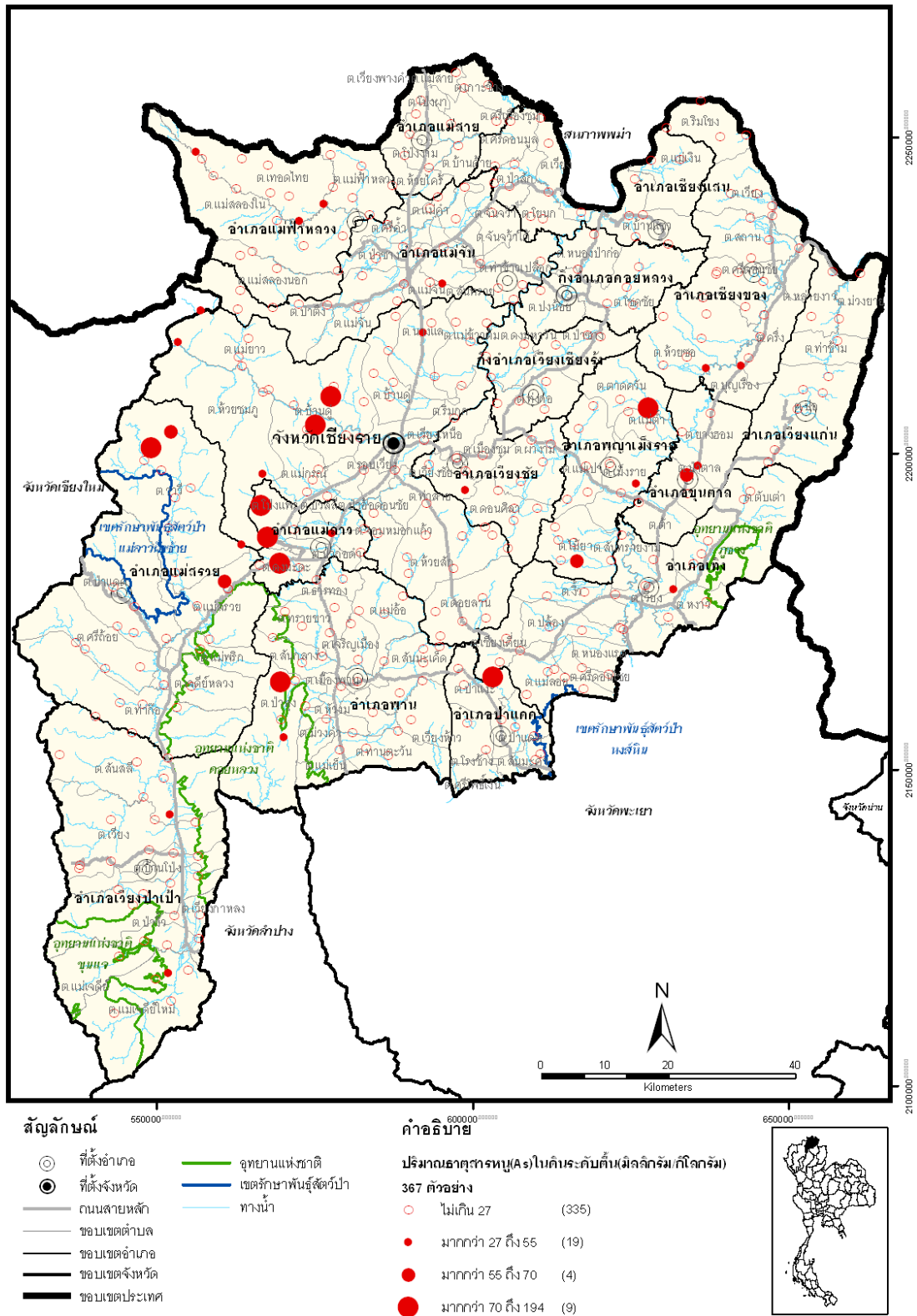


Figure 3. Arsenic distribution in residual soil, Chiang Rai Province.

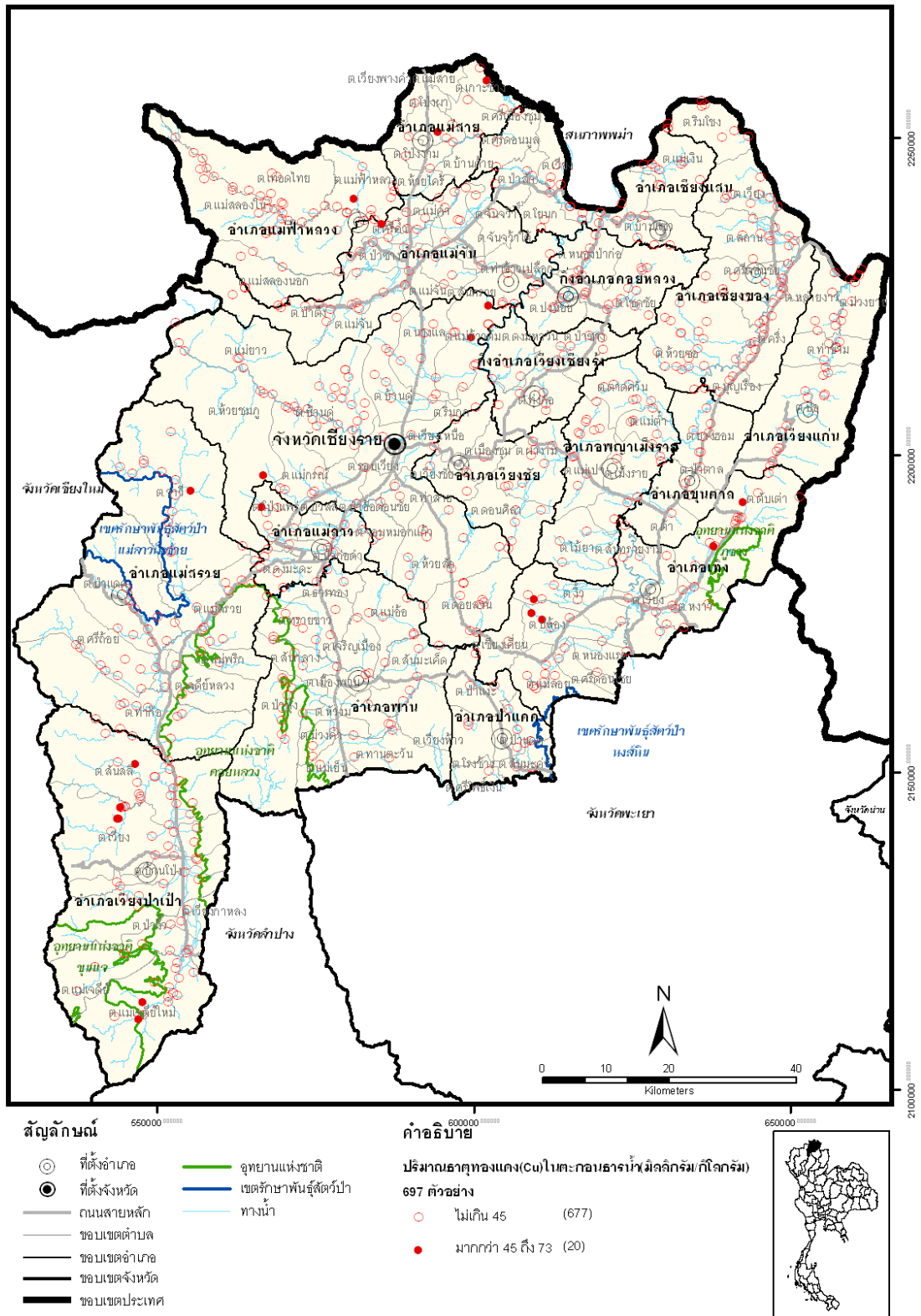


Figure 4. Copper distribution in stream sediment, Chiang Rai Province.

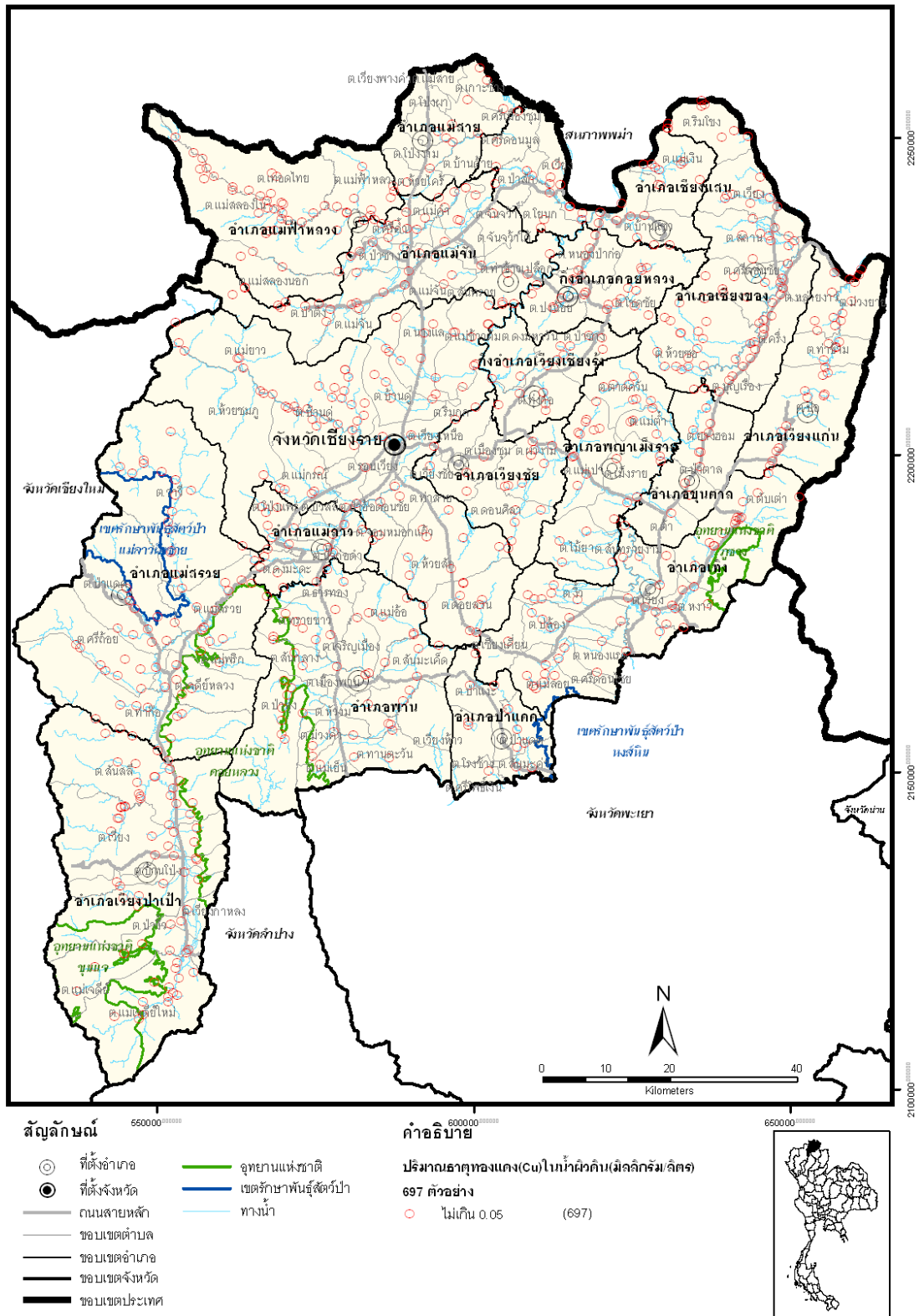


Figure 5. Copper distribution in surface water, Chiang Rai Province.

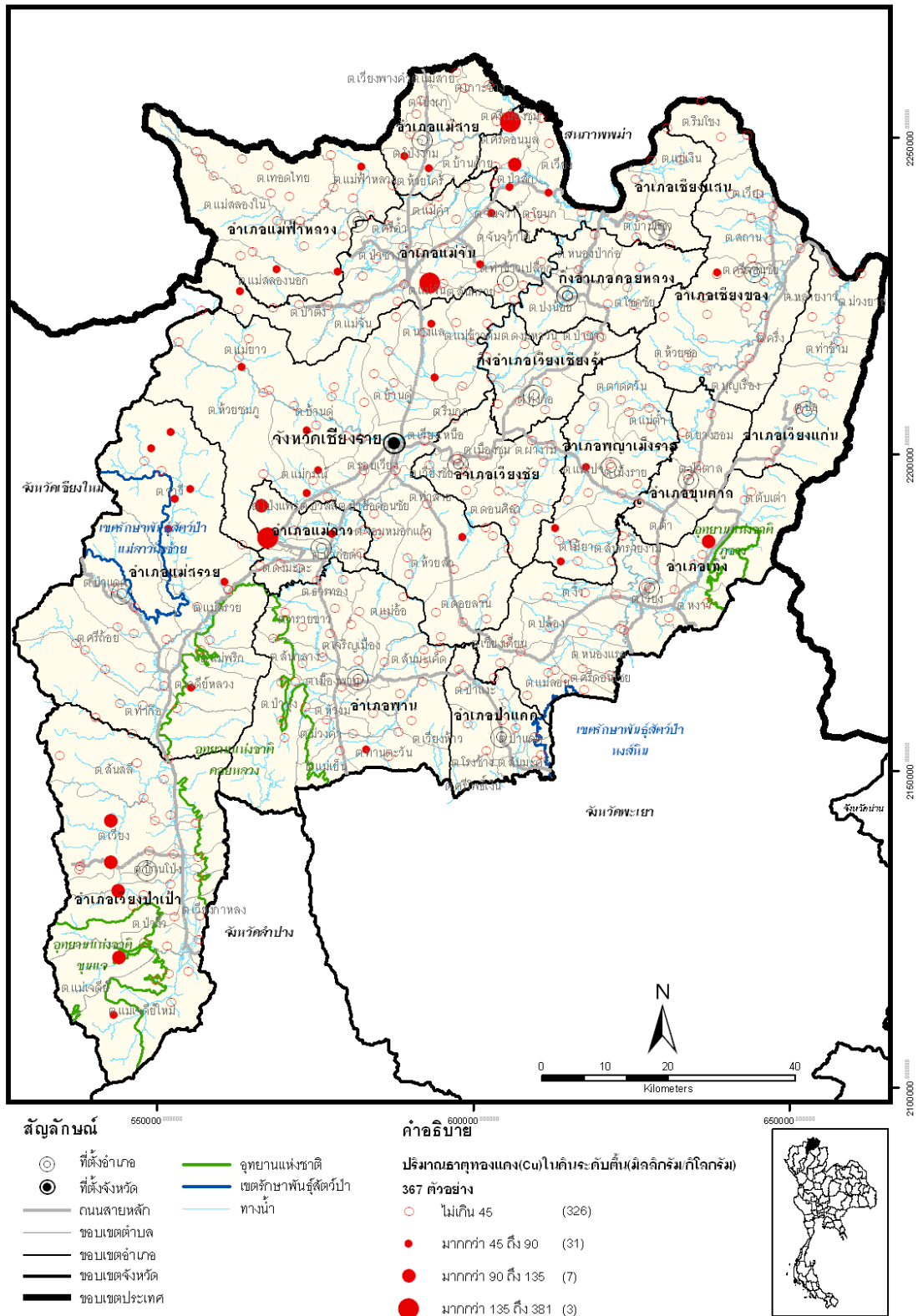


Figure 6. Copper distribution in residual soil, Chiang Rai Province.

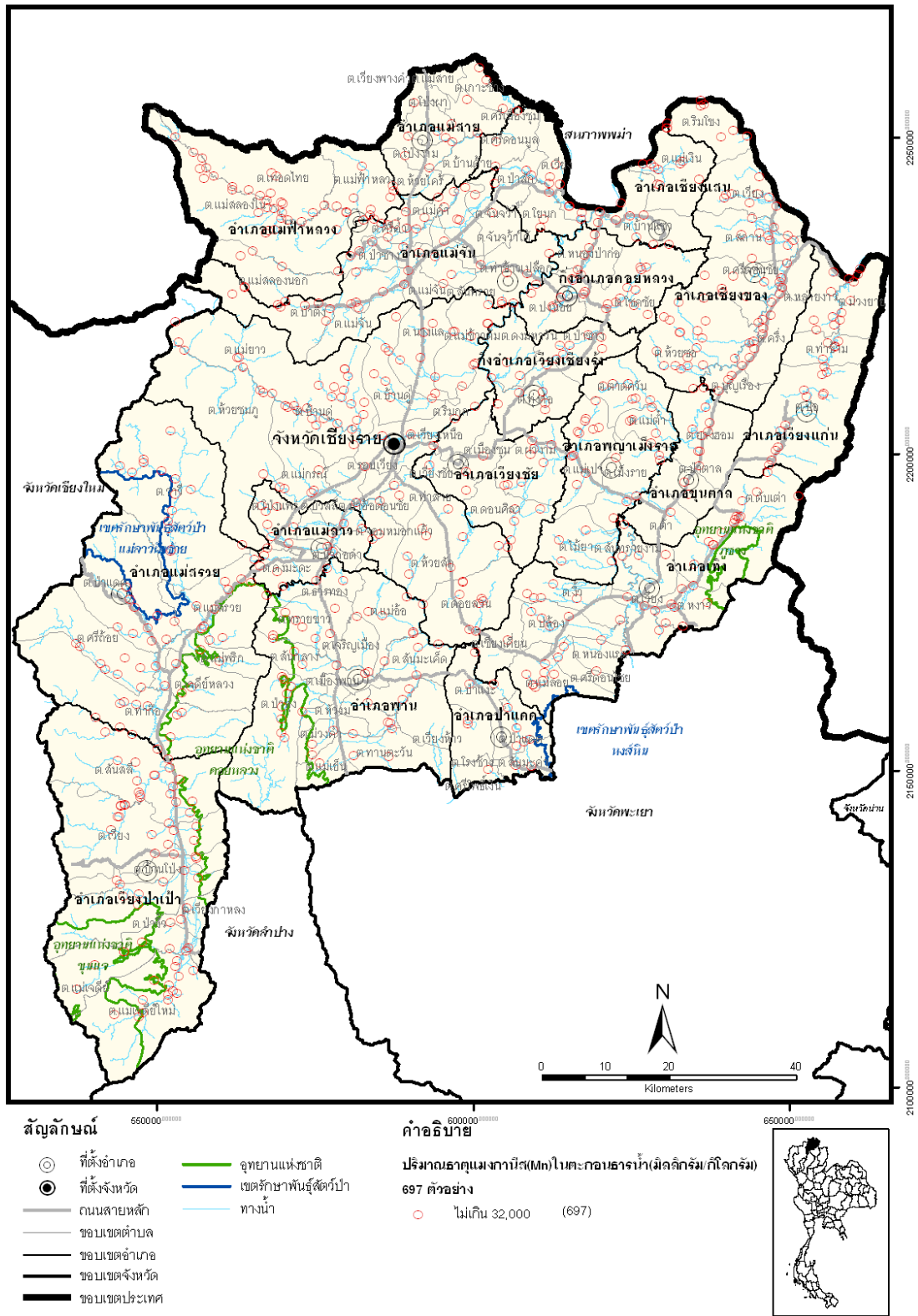


Figure 7. Manganese distribution in stream sediment, Chiang Rai Province.

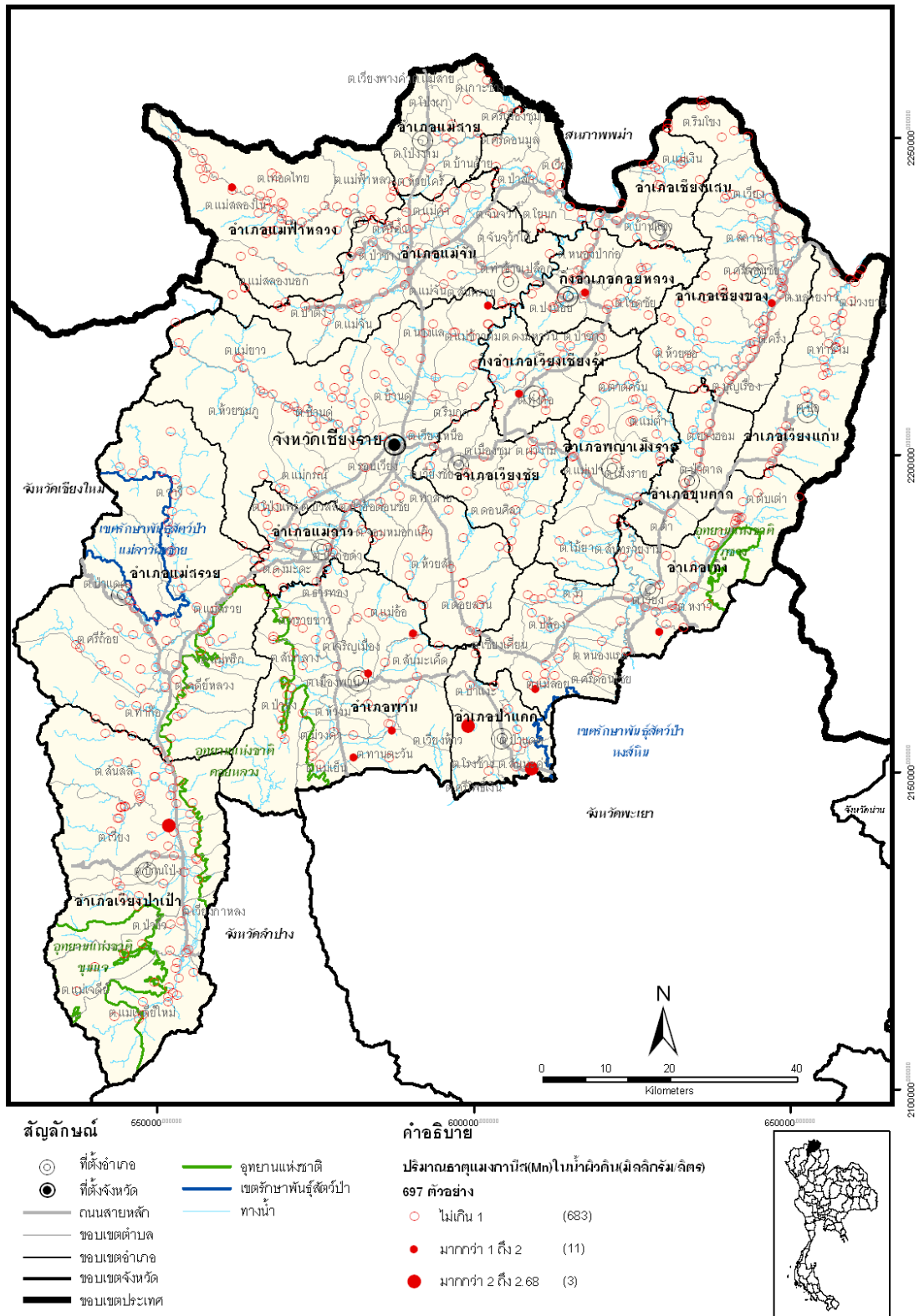


Figure 8. Manganese distribution in surface water, Chiang Rai Province.

GEO-INFORMATION SECTOR

1. GEO-DATA AND INFORMATION MANAGEMENT PROGRAMME

1.1 Summary

The 2nd phase of CCOP Metadata Project was launched in late March by the 1st workshop in China. Comments and seven code lists for draft metadata standard of CCOP Metadata due to ISO 19115, were considered and fulfilled. These were primarily stage of requirements on the development of metadata toolkit that will be done by CGS. DMR completed the requirements at the end of March, before the schedule. However, next activity being the approval of compiled code lists and final draft of metadata standard becomes late due to the schedule.

Concepts of geo-information exchange and sharing were contributed to DMR staffs that were extended from the participation on the CCOP-AIST GEO Grid training course at Tsukuba. Four research proposals were kindly approved and accepted for ASTER imagery data and DEM retrieval from the GHZ VO in the GEOGrid web portal. These data were honorably used as supporting information in the salinity research project in the northeast region, one of the King's initiative project held by DMR.

1.2 Annual Review of Technical Programme/Activities

1.2.1 CCOP Metadata Project Phase II

The 1st workshop of the project was launched during March 17-21, 2008 in Hainan, China. The working group agreed to adopt ISO 19115 for a draft metadata standard of the project. The draft metadata standard consisted 45 items and 8 code lists that were combined in 5 packages. The China Geological Survey (CGS) is nominated for the development of the toolkit that will be ready to use at the end of 2009. The workshop had setup flagship in development and implementation of the whole project. Member-participations for consideration and fulfillment of code lists were prior required within May, 2008. Compilation of all comments and code lists will be circulated for acceptance before June. Then, the standard declaration will proceed at the end of this year while the toolkit continues through the development plan.

DMR had considered the draft metadata standard and completed 7 code lists that were sent to CGS since end of March. However, the next schedule that is the approval of final draft and compiled code lists acting by CGS and secretariat is currently delayed.

1.2.2 Global Earth Observation Grid (GEO Grid) Initiative

Advanced Industrial Science and Technology (AIST) and Geological Survey of Japan (GSJ) hosted for the CCOP-AIST GEO Grid training course during January 21-24, 2008 at Tsukuba, Japan. The 2nd GEO Grid Workshop at Akibahara Convention Hall, Tokyo was also included in the hosted program. Coordinators in geo-information of member-countries were attended. The grid technology and online applications were introduced. GIS data exchange and sharing through the internet due to OGC's standard on web services were integrated in the GEO Grid portal. ASTER imagery data and digital elevation model (DEM) are available online for all registered members.

DMR coordinator had arranged the institutional meeting on March. The focus groups were DMR staffs carrying out researches and field works in geosciences. Regulation and available data were explained. These encouraged submission of 4 proposals in the GHZ VO (Geohazard and geology Virtual Organization). Half of those proposals were applied for geohazard prediction and mitigation, the rest were applied for gravity correction of earth surface and for estimated reserve of mineral resources evaluation. Besides, both ASTER data and DEM due to the geophysics proposal had been honorably used in the salinity research project in the northeast region that is one of the King's Initiative Project.

1.3 Purposed Future Activities and Assistance Required from CCOP in Supposed of Future Activities

a) Propose Future Activities

- Continuous participating with other member-countries in all activities for accomplishment of the CCOP Metadata Project Phase II.
- Continuous preparing geological map-metadata and associated thumbnail-maps for CCOP Metadata Project Phase II.
- Conducting web feature services (WFS) of geological and mineral data in KML format for dissemination, sharing and exchange through DMR website.

b) Assistance Required from CCOP

- IT specialists and in-house training courses in UML are required to increase productivities and conceptual models.
- Specialists and technical assistances for data correction in DEM from GEO Grid initiative project are needed.
- Specialists or in-house training courses in applications of multi-spectrum analysis in geohazard and geologic resources are needed for value added in GEO Grid initiative project.

1.4 Others

- Final draft of CCOP Metadata Standard and corresponding XML tags should be disseminated to all coordinators of the member-countries in order to manage and prepare geological map-metadata ready to use in Phase II.
- The GEO Grid initiative project should be nominated as official project of CCOP since it is valuable resource for research in geosciences.
- Technical Secretariat should regularly circulate information of all lived projects to coordinators and resource persons showing directions and activities to proceed.
- Technical Secretariat and coordinators should arrange meeting to encourage and advise for continuous approach of all projects.

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OTHER

1. GEOLOGICAL MAPPING

1.1 Summary

The Department of Mineral Resources carried out 1 : 50,000 geological mapping amounted to 50 map sheets between October 2007 - September 2008 in lower northeastern Thailand covering most parts of Ubon Ratchatani, Srisaket, Burirum, Surin and Roiet Provinces and their vicinities.

1.2 Annual Review of Technical Programmes / Activities

1 : 50,000 geological mapping round-up project (289 of total 830 map sheets covering 202,300 square kilometers) started in 2006 and expect to finish by 2011. Fifty map sheets were carried out between October 2005 – September 2006 in northern Thailand covering most parts of Chiang Mai, Chiang Rai and Lampang Provinces and their vicinities. Another 50 map sheets were carried out between October 2006 - September 2007 in upper northeastern Thailand covering most parts of Udon Thani, Khon Kaen and Kalasin Provinces and their vicinities. Fifty map sheets were investigated during October 2007 - September 2008 in the lower northeastern Thailand covering most parts of Ubon Ratchatani, Srisaket, Burirem, Surin and Roiet Provinces.

The next 30 map sheets will be carried out in central, western and eastern Thailand covering most parts of Kanchanaburi, Lop Buri, Chantaburi and Ratchaburi Provinces and their vicinities.

1.3 Proposed Future Activities and Assistance Required from CCOP in Support of Future Activities

Training course on Quaternary Geology

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2. SURVEYING AND REHABILITATION PLANNING FOR HOTSPRING

2.1 Summary

Hot springs occur in many provinces of Thailand, specially in the north, west and south. Many of them are located in the tourist attraction areas. The hot springs are important not only for the tourism business but also for the alternative energy resources, ecological and geological study. The Department of Mineral Resources (DMR) by the Geotechnic division has conducted surveys and development plans for some well known hot springs using geological and geophysical techniques.

In 2008, five hotspring sites have been further surveyed for possible extension or new undiscovered hotsprings around these sites. In some sites, the geophysical survey results indicate the shallow underground sources recommended for further drilling.

2.2 Annual Review of Technical Programmes / Activities

In 2008, surveying and development planning for hotsprings were conducted in the following areas:

(1) *Boh Klung Hotspring, Amphoe Suan Phung, Changwat Ratchaburi*: This hotspring is one of the most famous tourism sites in Ratchaburi Province. It is located in a valley near the old tin mine. Recently, there is a Royal project of the natural study park nearby. The Geotechnic Division has carried out the geological and geophysical surveys both inside the hotspring and the Royal project areas. The result indicates that there are faults and fractures extended from the hotspring into the Royal project area. Therefore there are some possible sites of shallow underground hotspring that are recommended for drilling in the future.

(2) *Thep Phanom Hotspring, Baan Om Kud, Tambol Kong Kaek, Amphoe MaeChaem, Changwat Chiang Mai*: The Thep Phanom Hotspring is a high temperature hotspring with the surface temperature around 90° C. It is easy to access and suitable for Eco-tourism and a source for hydrothermal energy. The survey result indicates 7 possible sites of shallow underground hotspring that are recommended for drilling and development in the future.

(3) *Baan Pak Poo Hotspring, Tambol Tam Na, Amphoe Kapong, Changwat Phang Nga*: This hotspring is one of the most famous tourism sites in Phang Nga Province. It is located near a stream and has potential for developing an eco-tourism site. The survey result indicates that this site is a potentially hydrothermal reservoir.

(4) *Phra Ruang Hotspring, Tambol Lan Dok Mai, Amphoe Mueng, Changwat Kampanghet*: This hotspring is located in the flat area with small hills and knobs. The survey result suggests that the hydrothermal reservoir is trapped in fractures with average depth of 3 metres. The resistivity survey result points out one possible underground reservoir along the survey lines.

(5) *Baan Wang Kham Hotspring, Tambol Sra Kruad, Amphoe Sri Thep, Changwat Phetchaboon*: This is located in the flat area a running stream in the center. The survey result suggests that the hydrothermal reservoir is trapped in fractures with average depth of 20 metres. The resistivity survey result points out two possible underground reservoirs along the survey lines.

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3. GEOSCIENCE ACTIVITIES IN CONTRIBUTIONS TO THE INTERNATIONAL YEAR OF PLANET EARTH (IYPE)

3.1 Summary

Thailand has appointed the National Committee of International Year of Planet Earth in April 2007. The Department of Mineral Resources (DMR) conducted various IYPE activities such as dissemination of geoscience knowledge and information to the public in terms of organizing geoscience conference, training workshops, research exercises for school teachers, students and general public and other public relation activities.

Three representatives of Thailand National Committee for IYPE, and two award winning students participated the Global Launch Event of the International Year of Planet Earth, 12-13 February 2008 at UNESCO, Paris, France.

DMR, in supporting the CCOP's contribution to IYPE, has officially participated in the CCOP Geoheritage Book and OneGeology projects.

3.2 Annual Review of Technical Programmes / Activities

In contribution to the International Year of Planet Earth (IYPE), 2007-2009, Thailand has appointed the National Committee of International Year of Planet Earth in April 2007. Mr.Apichai Chvajarenpun, Director-General of the Department of Mineral Resources was appointed by the Minister of Natural Resources and Environment to be the Chairman of the National Committee of International Year of Planet Earth. Secretary - General is Mr.Phitaks Ratanajaruraks. The committee comprises representatives from geoscience-related governmental and private sectors, universities and academic institutions.

The Department of Mineral Resources conducted various IYPE activities as the follows:

1) Organizing the International Conference on Geology of Thailand: Towards Sustainable Development and Sufficiency Economy (GEOTHAI'2007) on 21-22 November 2007, at The Emerald Hotel, Bangkok to celebrate the Auspicious Occasion of His Majesty the King's 80th Birthday Anniversary 5th December 2007, and the United Nations International Year of Planet Earth 2008. The themes of the conference include geology, geo-environment and hazards, mineral, groundwater and energy resources.

2) The Department of Mineral Resources as the focal organization for IYPE and on behalf of the National Committee for International Year of Planet Earth organized an event on national student contest by essay writing with topics related to earth sciences with the aim to provide the award winning students opportunity to gain valuable experience in the international scientific event.

3) The National Committees of IYPE of Thailand with two award winning students participated the Global Launch Event of the International Year of Planet Earth, 12-13 February 2008 at UNESCO, Paris, France.

4) Organizing training workshops in seven provinces for scientific teachers with objectives to disseminate geoscience knowledge. The geoscience context included the basic science of geology, environmental geology, geohazards, and geological resources in order to enhance their capacity of teaching geoscience to the students. This training course is a part of collaboration between the Department of Mineral Resources and the Office of the Basic Education Commission, Ministry of Education.

5) Organizing training for youths to be a guide from the selected schools all over the country to enhance their knowledge of basic geology and skill to disseminate their acquired knowledge to the public and Dinosaur conservation youth camps with objectives to raise awareness and cultivation of care of the youth in the invaluable scientific objects/evidence of the country.

6) Organizing geoscience exhibition with IYPE activities in the National Science weeks, 8-22 August 2008 at Bitec Convention and Exhibition Center, Bangkok.

7) Publishing a geoscience text book entitled Geology of Thailand, second edition in Thai Language.

DMR, in supporting the CCOP's contribution to IYPE has officially participated the activities as the following:

1) The CCOP Book Project Member Countries 1st Working Group Meeting, 18-19 July 2007, at University Kebangsaan Malaysia, Bangi, Selangor, Malaysia.

2) The OneGeology Project to provide geological map of Thailand, 1M scale online.

Proposed further activities are such as translation of key documents presented on the IYPE Corporation's website in Thai language and make available to the public.

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