CHAPTER II

METHODS OF STUDY

2.1 Sampling Design

Due to the fact that approximately 65 per cent of the total tin-concentrate production of Phuket comes from existing tin-mines in Kathu Valley, it is therefore considered that heavy minerals associated with tin ore in this area are significant. The sampling design under the present investigation is basically based on the relatively better defined geological condition of the Valley as compared with other area. In addition, there are quite a number of active tin-mines with considerable production from many rich tin-deposits. It is against this background, the present sampling programme has been designed to obtain valuable and diversified heavy mineral associations from a unique cluster of tin mines in the Valley.

Considering from the geological point of view, it is apparent that almost all of active tin-mines in the area are located in deeply weathered primary deposits of pegmatitic and pegmatitic/colluvial origins. Therefore, the heavy minerals characteristics of these mines are closely related to the stable rock-forming minerals of the primary deposits. The effects of surface processes other than weathering will undoubtedly play only minor role in most cases. The only complication regarding the deposits lies in the complexity of phases of mineralization in each of the deposit.

Despite the fact that the geological setting of Kathu Valley is relatively better defined as compared with other areas, detailed geological condition of each tin-mine in this area is poorly worked out. The traditional exploitation of extraordinary rich deposits

simply discourages the operator to realize and fully utilize the detailed geological knowledge in assisting the mining operation. The economics of the deposits appear to be the only constraint in tin-mining industry in this area. This has a strong repercussion on the present sampling design and the interpretation of the analytical results. It is therefore necessary to extend part of the scope of the investigation into every possible detailed geological background of the sampling locations concerned.

2.2 Sampling Method

Ideally, the heavy minerals samples for this study should be collected directly from the deposits of deeply weathered mineralized zone under the soil cover. However, it is realized from the practical point of view that, in order to obtain enough heavy minerals for further analysis of 1 kilogram, it is necessary to concentrate these minerals from the total materials of 6 cubic yards. It is therefore evident that a sizeable material must be excavated in order to obtain the required amount of heavy minerals for this purpose. In addition, most of the owners of tin-mines do not permit the sampling programme earlier stated to be carried out in their mining-lease areas.

Eventually, it is decided to carry out the heavy minerals sampling programme from the palong of each tin-mine which is considered to be most possible representative of the in situ condition of the deposits.

Prior to the actual sampling programme, the study has been made in order to fully understand the whole processes of tin mining in Kathu Valley. All of the tin mines in this area use a gravel pumping mining method. Giants or monitors, as they are generally called, are employed in the stripping of overburden and the breaking down of the

gravel banks by hydraulicking. In addition, excavation and breaking up of the gravel bank in some cases have been assisted by power-shovels. After this, the washing and disintegrated materials are collected into a sump which is generally excavated in a bedrocks.

The mixtures from the sump is brought to an elevated line of sluice by means of gravel pump. The delivery pipe of the pump conveys the material to a line of elevated sluice boxes, usually supported on trestles, which are set at a convenient height to discharge the tailings clear of the paddock. At the head of the sluices, a rock trap or inclined grizzy is fixed, over which the pump material is delivered. All large stones and boulders are thus removed, whilst the undersize, consisting of fine stones and gravels, falls into the sluice boxes below. Generally, there are two sluice boxes, notably, sluice box for coarse-grained materials, and sluice box for fine-grained materials. The overflow of the sluice from the first box goes into the second box and eventually overflows into the palongs.

Tin ores and associated heavy minerals are recovered from the coarse, and fine-grained sluice boxes including from the palongs are eventually collected in the ore bins. Sampling of the detrital heavy minerals, for the amount of approximately 1 kilogram, is carried out from these ore bins for further study. In order to obtain a homogenized and representative sample, the detrital heavy minerals are well mixed prior to the actual sampling. Besides, the standard sampling rod without baffles is employed to assist the proper sampling programme.

2.3 Sampling Location

Altogether 8 samples were collected from various tin-mines within the Kathu Valley (Fig. 2.3). In addition, 7 samples were

SAMPLING LOCATION MAP OF THE STUDY AREA

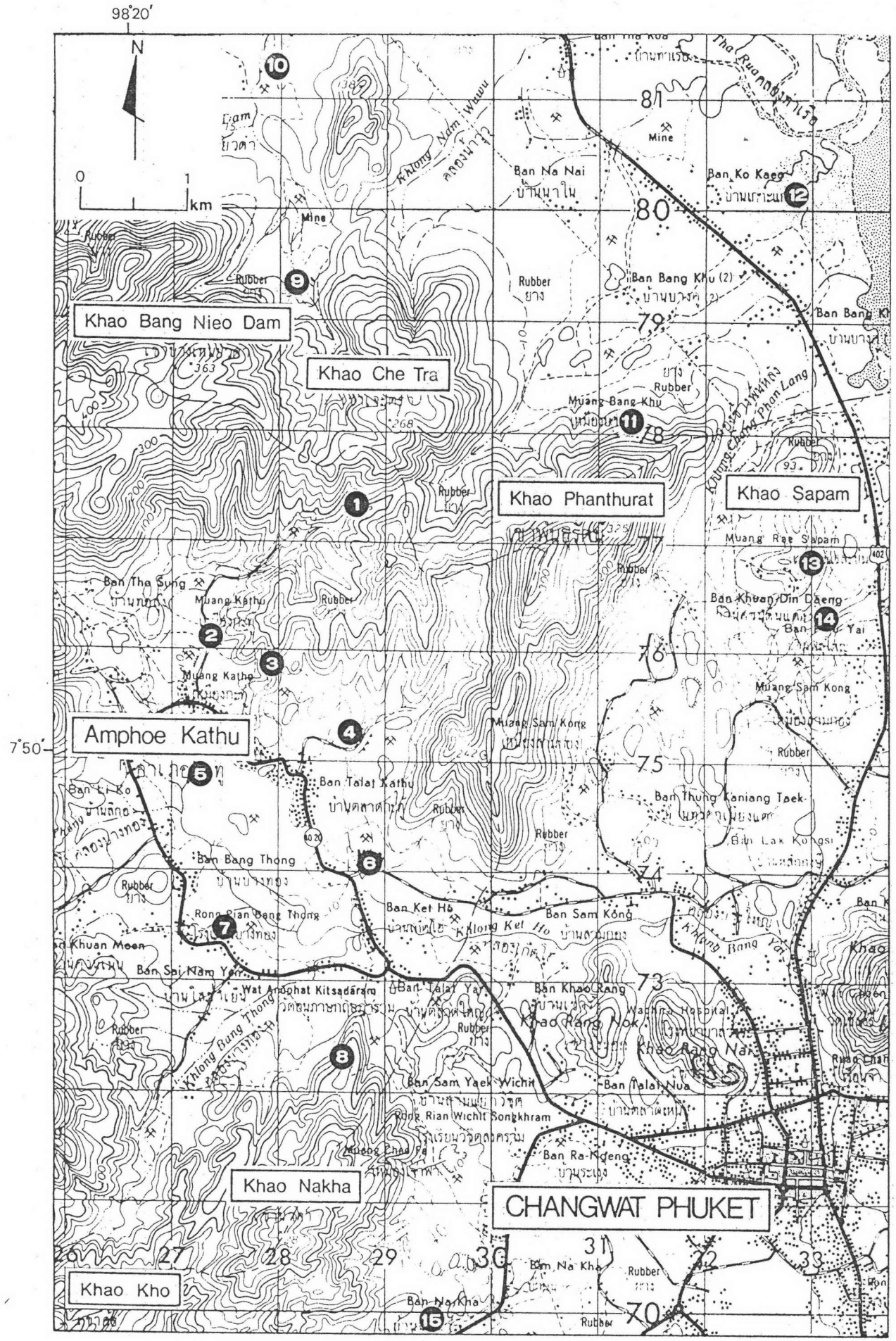

Figure 2.3 Sampling locations of tin-mines under the present investigation.
(● Sampling location - refer to chapter III)

collected from other neighbouring area outside the Valley. They are 2 samples from 2 tin mines in the north-northeastern part of the Valley, 4 samples from 4 tin mines on the eastern coast of Phuket in the northeastern part of the Valley, and the last one from tin-mine in the southern part of the Valley (Fig. 2.3). Detailed information regarding all 15 sampling locations is summarized in Table 2.3.

2.4 Laboratory Study

2.4.1 Sample preparation

The sample from each mine was washed and dried at 110°C in the oven prior to the sample splitting using Jones sample splitter. Generally, the sample of approximately 200 gms is required for further laboratory study, and additional 100 gms of sample is kept for reference.

2.4.2 Grain-size Analysis

The total amount of approximately 200 gms of sample was used in the grain-size analysis by sieving using a series of standard hand sieves of 4 inches diameter. Altogether, 6 hand sieves of the following apertures; 10, 20, 40, 60, 80, 100 ASTM mesh nos. including pan and cover are used. As a consequence, 7 different grain-size fractions are obtained from the grain size determination. At this stage, the weight percentages of heavy minerals in each size fraction were also determined, and graphic representations of the heavy mixtures of each sample were prepared in the forms of pie diagram and cumulative curve.

In addition, the grain-size distribution of only cassiterite was determined and expressed in the forms of pie diagram and cumulative curve for each sample. Grain-size parameters, namely, graphic mean, median, and sorting were determined for heavy fraction

Table 2.3 Detailed information of the sampling locations.

Sample No.	Grid Reference	Name of Tin-Mine	Owner	Tin Ore Production Kg/month
1	288/774	Tor Soong	Mrs.Chunrim Hri-chantanawong	5,400-7,200
2	274/761	Tantikowit	Mr.Chuyin Tanti-wit	12,600
3	279/759	Pad Roi	Mr.Chuyin Tanti-wit	6,000
4	288/752	Ban Nguan	Mr.Bunlue Tanti-wit	12,000
5	273/749	Pin Yoh	Mr.Bunlue Tanti-wit	10,800
6	289/741	Kathu	Anupas&Son Co. Ltd.	7,200
7	275/735	Tungtong	Mr.Keng Limpanon	6,000
8	287/723	Pol Thavee	Mr.Nikom Bam-roongsin	4,800
9	282/793	Sapayakorn	Mr.Preecha Udomsap	4,500
10	279/812	Sinpatana	Mr.Veera Chirayus	9,000
11	313/781	Sap Bangku	Mr.Kanit Yongsa-kul	9,000
12	329/801	Lun Seng	Mr.Kanit Yongsa-kul	8,400
13	330/769	V I P	Mr.Chairat Senee-tantikul	7,800
14	331/764	Sahakit	Mr.Termsak Fong-srisin	10,800
15	295/699	Chao Fah	Anupas&Son Co. Ltd.	13,200

Sources: The Mineral Resources Region Center, Region II, Phuket.

of each sample.

2.4.3 Mineral separation

For each sample, the separation of light and heavy minerals in each size fraction was carried out using heavy liquid separation technique. The heavy liquid employed in the study is bromoform (S.G.= 2.89 at 20°C). The standard procedure and equipments for heavy minerals separation using bromoform is used (Fig. 2.4.3). The weight of heavy minerals in each size fraction was determined.

2.4.4 Microscopic mineral identification and estimation

The heavy liquid separation of detrital mineral samples was carried out prior to the microscopic mineral estimation in order to maximize the accuracy of mineral estimation by grain-counting method. The total amount of heavy minerals in each size fraction was splitted using cone-quartering method to obtain the required representative sample weight of approximate 2 gms. The heavy minerals of each size-fraction were classified and separated into 3 groups according to the degree of magnetic susceptibility using hand magnets. This procedure would enable the 3 heavy mineral groups to be falled within the 3 different magnetic susceptibility, namely, 0.3 ampere, 0.35 ampere, and greater than 0.35 ampere in the Frantz isodynamic magnetic separation scale (side slope 9°, forward slope 10°).

The estimation of each heavy mineral in each magnetic group is determined by the microscopic ribbon grain-count method. Besides, the specific gravity of each identifiable heavy minerals is determined using pycnometer and micropycnometer method. The weight percentage of each heavy mineral in any magnetic group for each size fraction is then calculated against the total weight of each magnetic heavy mineral group using the number of grain-count and the specific gravity.

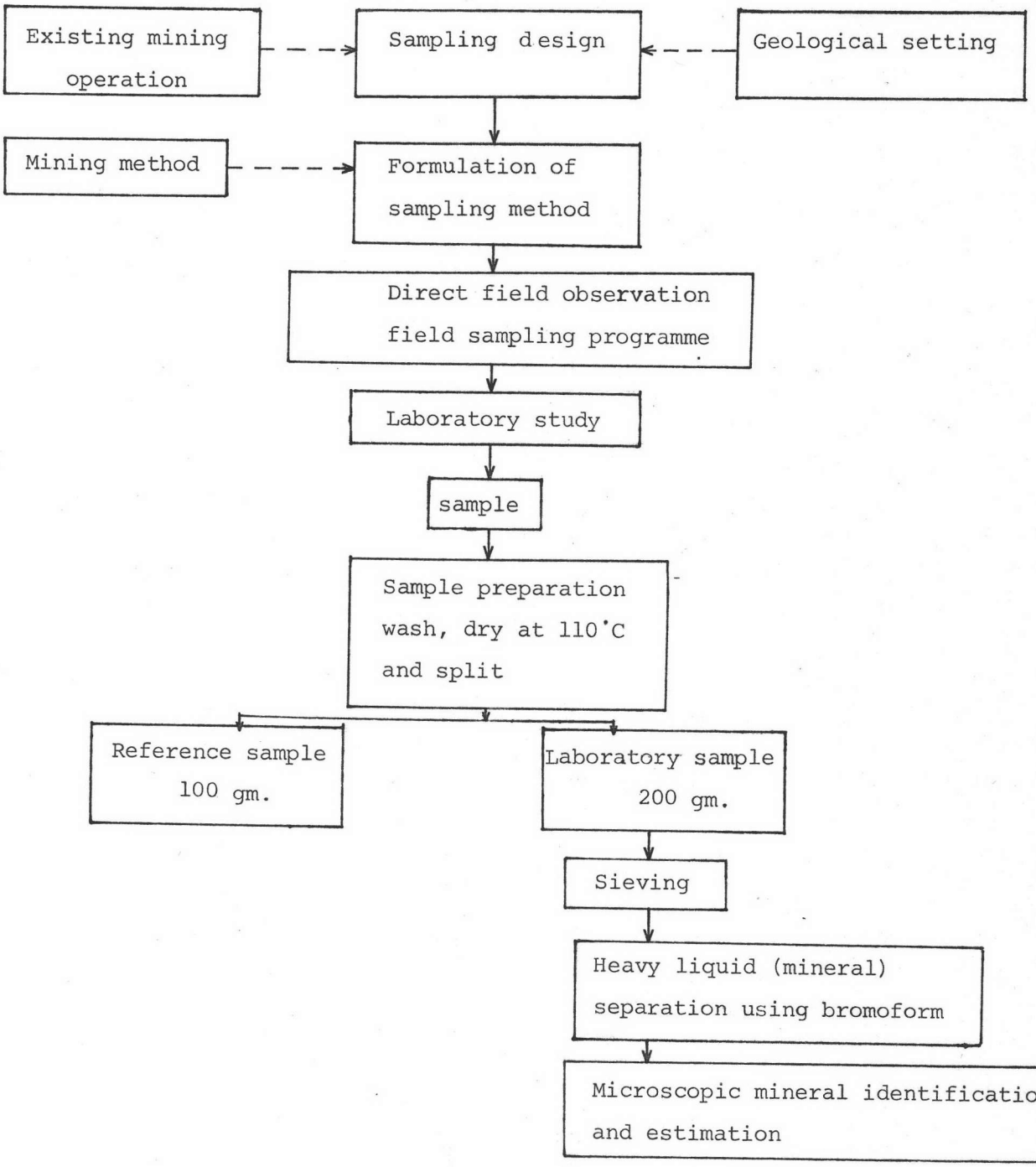

Figure 2.4.3 Flow chart illustrating the sample treatment

Eventually, the weight percentages of each heavy mineral in the total heavy mineral sample were calculated from the summation of weight percentages of that mineral in each size fraction.

It is noted that the mineral identification of all heavy minerals present in all samples must be firmly estabished before the application of the microscopic mineral estimation. In order to confirm the mineral identification under microscopic technique particularly regarding some doubtful minerals, additional X-ray diffractometry, visual spectroscopy, microchemical test, or mineral treatment including the standard optical mineralogy techniques were employed whenever required.

The overall study procedure of heavy mineral under the present investigation can be summarized and presented in Figure 2.4.3

In order to retest the reliability of sampling programme employed in the present investigation, two sampling programmes had been carried out. The first sampling programme was carried out during October 1982 and the second sampling programme was carried out in December 1983. The subsequent laboratory analysis of these two sets of samples were carried out for comparison purpose. The result of sampling programmes and laboratory analyses reveals that the nature and characteristics of heavy mineral assemblages of these two sets of samples are conformable within the acceptable limit. Therefore, it is concluded that the sampling programme and laboratory analyses under the present investigation is validated. The reproduced ability is $\pm$ 2 %.