CHAPTER V

FIELD STUDY ON THE STRUCTURAL GEOLOGY

The field study of the mesoscopic stuctures was done in concurrent with the stratigraphic study. It was aimed to record the evidences of all structures which can be seen in the outcrops or hand-specimens and to summarize and describe their appearance. Furthermore, some oriented rock specimens were to be collected back to the office for a closer look on the structures not readily observed in the field.

It had been observed that the regional strike of the rock units mostly lies in the east-west direction in the western portion and changes the course slightly to the southeast-northwest direction eastwardly. Generally, the dips are fairly moderately to the south and southwest directions.

The small-scale folds in the inclined rock units were also observed. The folds are of the gently plunging, upright to inclined, close, symmetric and asymmetric kind, and gently plunging inclined overturned asymmetric kind. These folds trend parallel to the regional strike and gently plunge to the east and west. All folds except the overturned ones are found in every rock units in the area.

The overturned minor folds are especially limited to the X2.2 member at Khao On, Khao Mai Nuan, Khao Phu Phe, Khao Tham, Khao Lom Phal and Khao Nam Tok, and to the X5.3 member at Ban Phu Khae.

Furthermore the faults were commonly revealed. They are normal-, reverse-, and left-lateral and right-lateral strike-slip faults. The faults of the first two kinds trend generally east-west and southeast-northwest. The left- and right-lateral strike-slip faults trend commonly in the north-south and northeast-southwest directions. The brecciated rocks were commonly reported in the topographic lows occupied by these faults.

There are both volcanic and intrusive igneous activities occurred in this area. The contact metamorphic zones were generally observed in the stratigraphic rocks around the intrusive bodies. The irregular boundary between the younger volcanic rocks and the older sedimentary rocks was observed to be an angular unconformity.

5.1 The Study Subareas

To perform a structural correlation, the study area was subdivided into five structurally homogeneous subareas as shown on Figure 43. Each subareas are bounded by the surfaces of discontinuity, in this case the faults or some unusual boundaries between the successive rock layers, the rock unit boundaries, or axial trace. In each subarea, the bedding plane orientations were recorded and analyzed using the lower-hemisphere equal area stereonet plots, the ¶-diagrams. The patterns of distribution of these bedding plane orientation were used to construct the representative schematic fold models, then the three-dimensional structural models for these structural zones.

Besides, the planes of cleavages, minor fold elements, fault planes and other penetrative structures (which have the properties of

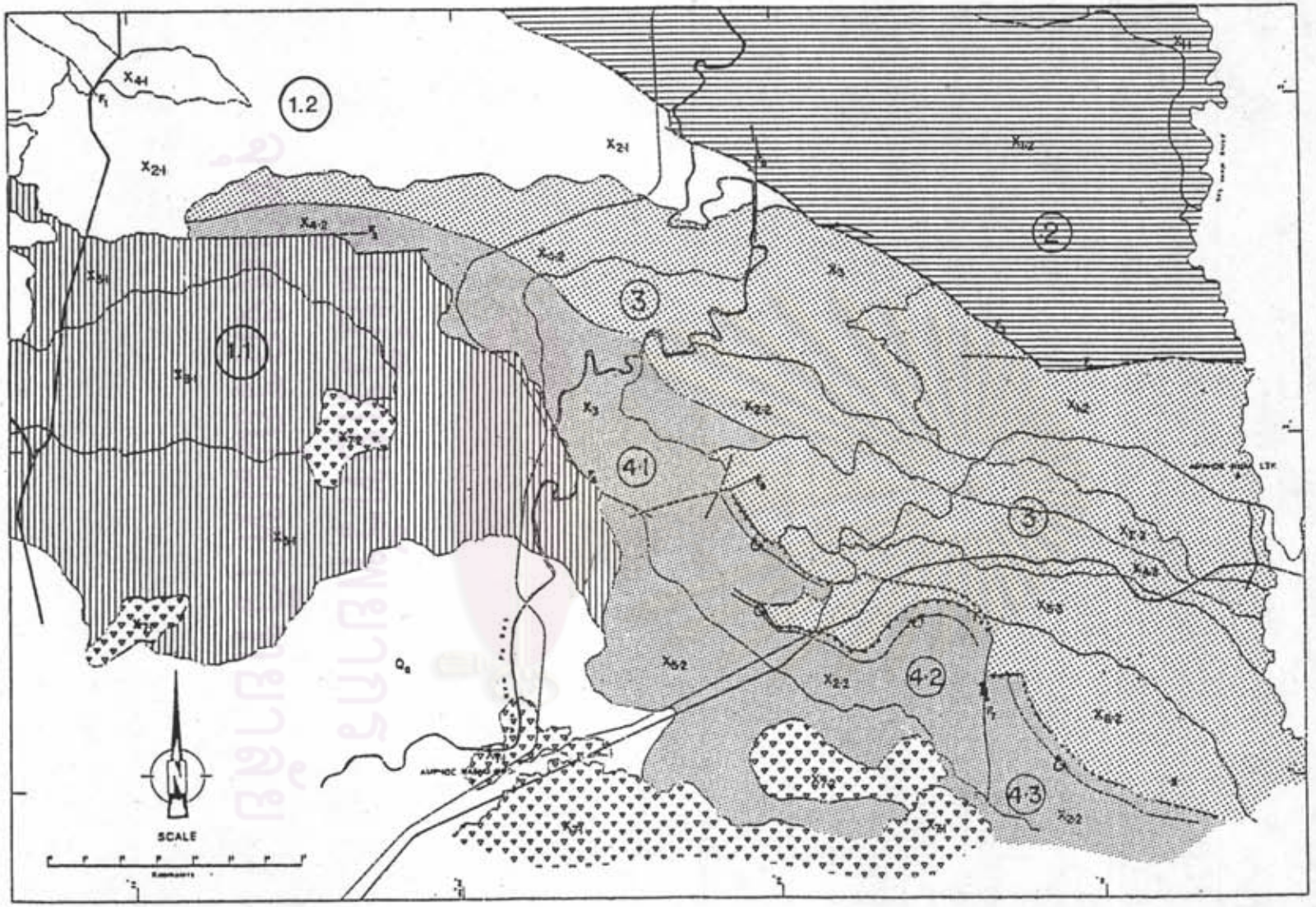

Figure 43 The structural-subarea location map. The subareas are 1.1,1.2,2,3 and 4 (white and shaded areas). Subarea 4 was further subdivided into 4.1,4.2 and 4.3 as two cross-cutting faults were reported in it.

the petrofabrics) were similarly analyzed to contribute the additional information.

5.1.1 Subarea 1.1

Subarea 1.1 includes the stratigraphic members X5.1 and X6.1 (Figure 44). The bedding planes mostly strike easts-outheast and incline to the southern directions with the moderate to rather steep dip values.

Associating the uniformly inclined strata were the minor lower-order folds. The folds are close to open, with the subrounded to subangular hinge area and mostly gently plunging to the west. Besides, in the thin-bedded chert of X5.1 member at the grid reference 05232168, the folds were found to be of the overturned Z-type when looking west along the fold axes.

The stereonet plots of the poles of the bedding planes resulted that the bedding plane orientations are rather uniform (with the variation causing by the said minor fold limbs). The Z-type lower-order folds suggest a regular southward-dipping fold limb in this subarea.

5.1.2 Subarea 1.2

Subarea 1.2 contains the rocks of X4.1 and X2.1 members. The bedding plane orientation mostly inclines to the south with the dip values varying from 25 to 50 degrees. The very gentle dip, or even the dips toward the northern directions were occasionally observed forming a large upright open fold whose center locates at Kilometer 8 on Highway 21. This mentioned fold is shown in the geologic cross section between Kilometers 7 and 12 (Figure 45 a).

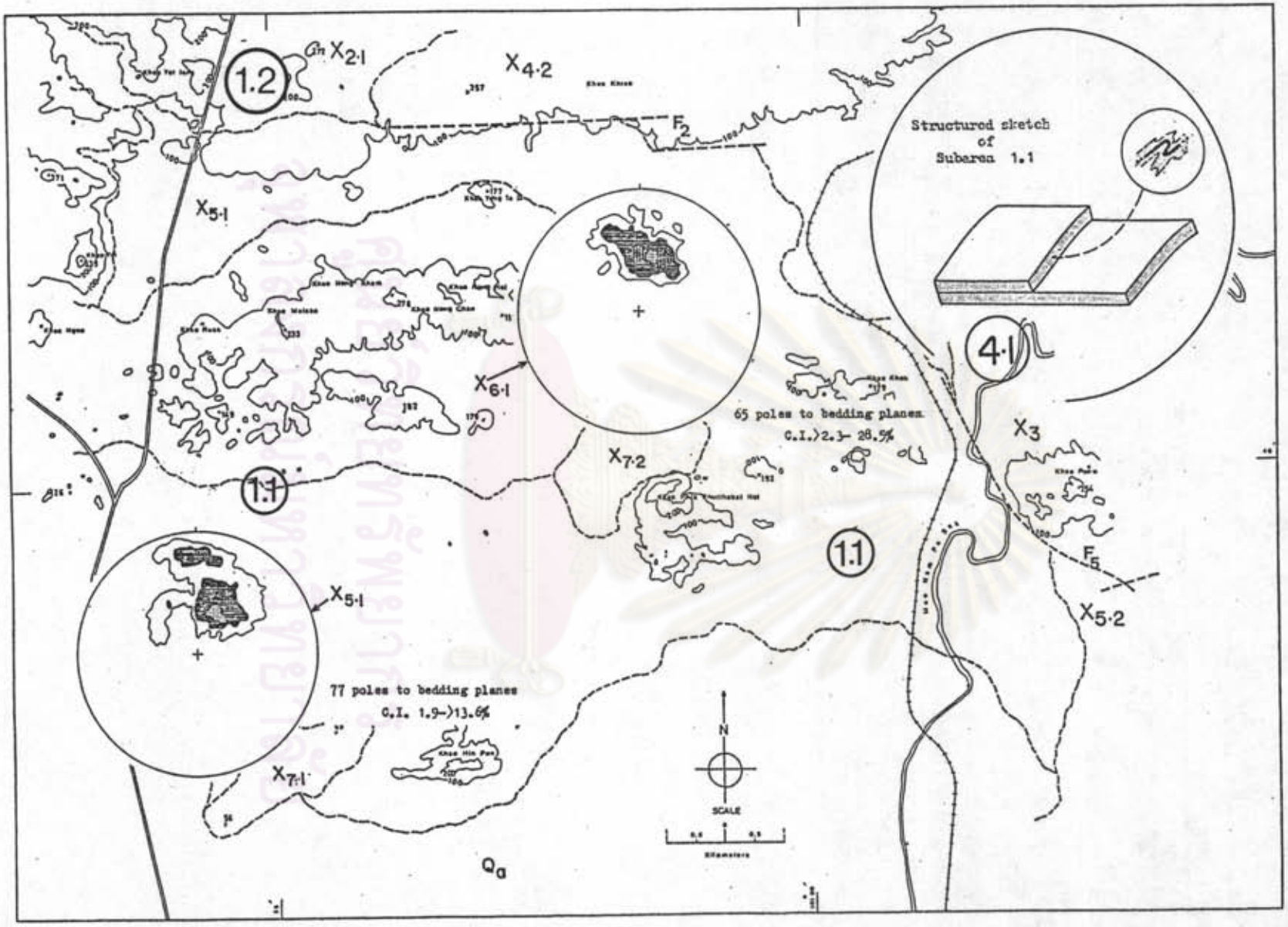

Figure 44 Map of Subarea 1.1. The stereonet plots of the bedding plane orientations of X5.1 and X6.1 members and the 3-dimensional structural model of the subarea were also illustrated.

The minor folds as seen in this subarea were mostly gently plunging, inclined to upright, and close to open with a subrounded to subangular hinge area. Their axes oriented in several directions (Plate 1).

A normal fault designated "F1 fault" in Figure 45 was observed. The fault strikes 154 degree azimuth and dip 62 degree southwestward. This fault brings the rocks of X4.1 member down to contact those of X2.1 member.

The stereonet plots of the poles of bedding planes for each rock member confirm the field observation. The distribution pattern of the data also reveals a hidden undulating upright cross fold system whose fold axis plunges moderately to the southwest. The nature of the cross fold system is yet to identify.

A 3-dimentional structural model for subarea 1.2 was constructed (as shown in Figure 45 a) as a southward-dipping fold limb with a large east-west trending lower-order fold.

5.1.3 Subarea 2

The subarea occupies the northeastern part of the study area and contains essentially the rocks of X1.1 member and a large portion of X1.2 member. The subarea was separated from Subarea 1.2 and 3 by F3 and F4 faults (Figures 43 and 45 b). From the field observation, it had been found that the bedding planes mostly inclined to the south with the varying dip values between 25 - 60 degrees. The bedding plane orientation to the other directions was also observed with the dip values varying from 15 - 80 degrees. The details of varying orientation of bedding plane are also illustrated in Plate 1.

Furthermore, the associating minor folds were observed to be close to open, inclined to upright, gently plunging, symmetric to asymmetric. The fold axes trend mostly southwestward, while toward the other directions are also common.

The orientation of the poles of the bedding planes in the ¶-diagram shows a pattern of distribution, as seen in Figure 45 b, of the similar southward-dipping pattern as elsewhere. However, an angular upright cross fold system whose axis plunges moderately to the southwest was obviously noted. The structural sketch in Figure 45 b clearly illustrates refolded fold (?) pattern.

5.1.4 Subarea 3

Subarea 3 covers the normal limb of a major overturned syncline in the study area (Plate 1). The important physiographic features in this subarea include Khao Chan, Khao Makok, Khao Yai, Khao Pha Daeng, Khao Pha Kaew, Khao Ruak, Khao Mai Kwian, Khao Hua Lon, Khao Hin Dad (Figure 46 and 47). The rocks being covered are those of X1.2, X2.2, X3 and X4.2 members. The subarea is separated from Subarea 2 in the north by F3 and F4 faults while Thap Kwang Thrust and the axial trace of the major overturned syncline mark the subarea boundaries in the southwest from subarea 4. The rest of the subarea boundaries are of the rock types boundaries.

The bedding planes mostly trend east-west and southeast-northwest, and incline to the south and southwest directions. The dip angles were mostly between 30 - 70 degrees. The geometric features of the associating minor folds were generally characterized by a series of horizontal to gently plunging, close and open, upright to inclined asymmetric and symmetric folds with a subrounded to

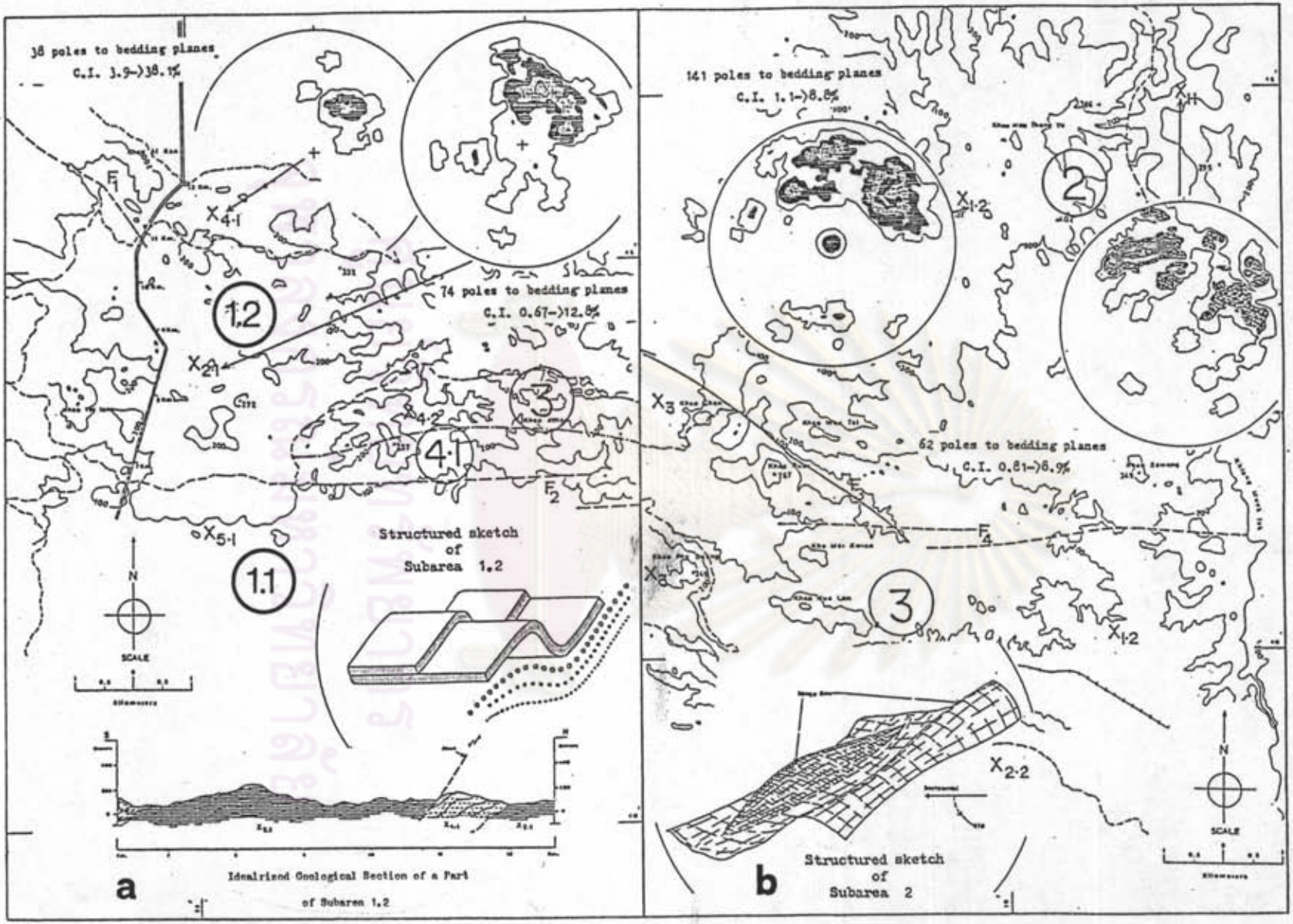

Figure 45 Maps of Subareas (a) 1.2, and (b) 2. The stereonet plots of the bedding planes of various stratigraphic members and the structural models were illustrated.

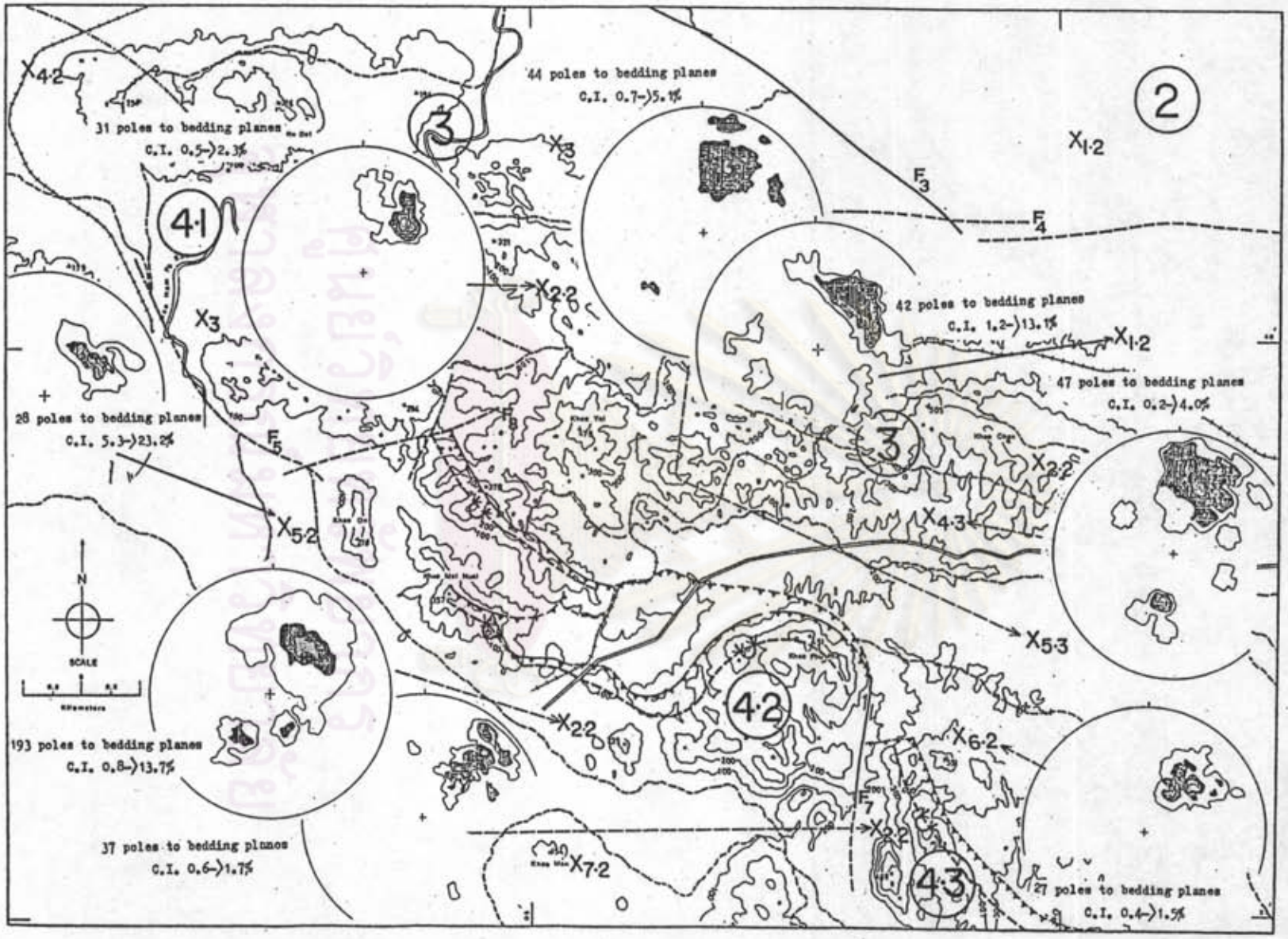

Figure 46 Sterconet plots of bedding planes in Subareas 3 and 4.

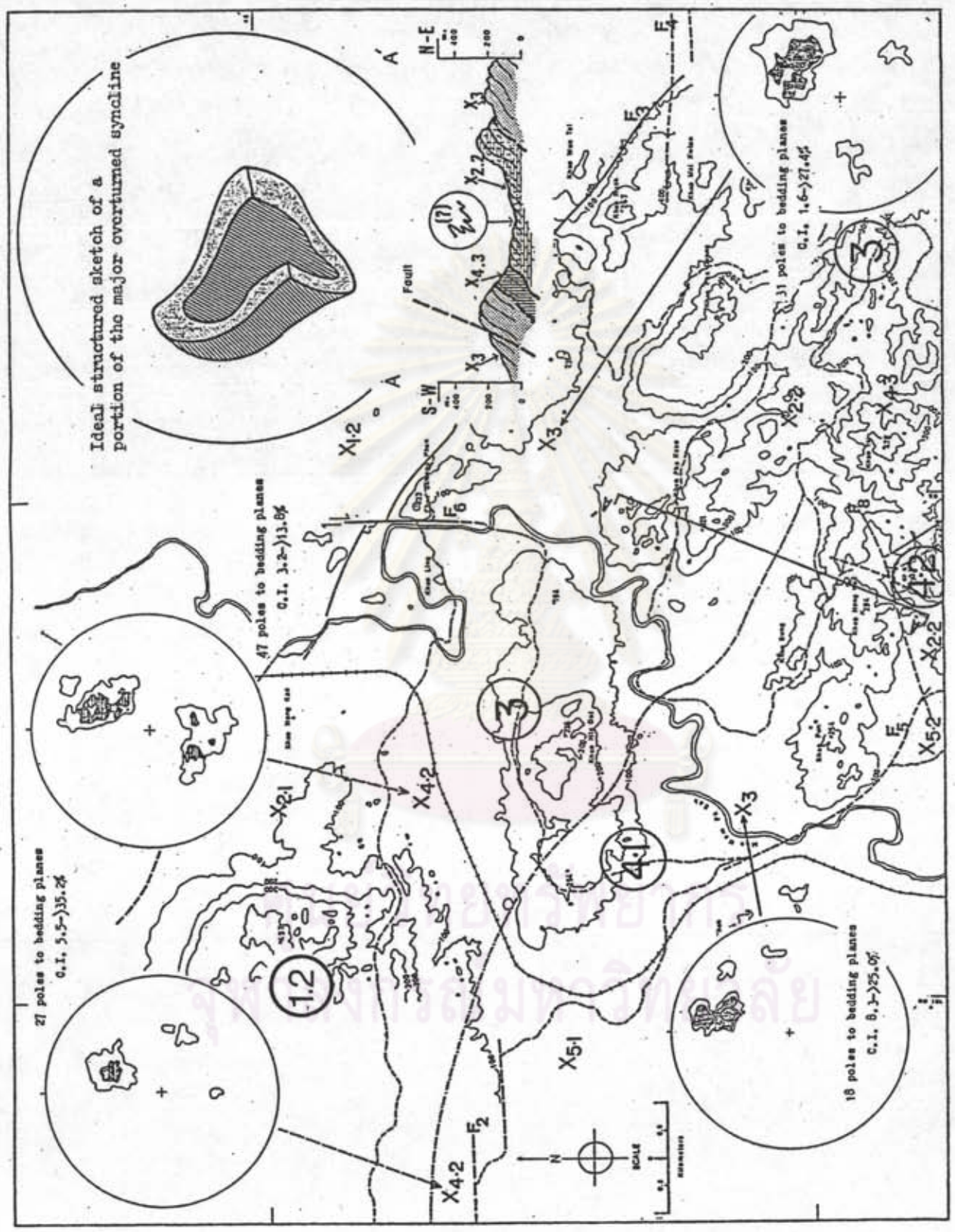

Figure 47 Stereonet plots of bedding planes in Subareas 3 and 4. A 3-dimensional structural model and an ideal geologic cross-section are also illustrated.

subangular hinge area. These folds commonly exposed along the road to the microwave-transmission communication station on Khao Chan. The detailed study here will be mentioned later.

The stereonet plots of the poles of the bedding planes for each rock unit were performed. The results of this test suggested that the bedding planes orientations were mostly uniformed by inclination of dip to the southwest direction with some associating lower-order folds and perhaps some undulating upright cross folds too.

5.1.5 Subarea 4

Subarea 4 is where the overturned limb of the major overturned syncline locates. The subarea is opposite to Subarea 3. The physiographic features are of Khao Nam Tok, Khao Lom Phat, Khao Tham, Khao Phu Phe, Khao Mai Nuan, Khao On, Khao Pun, Khao Sung, Khao Hin Dad and Khao Khrao, while the rock types are of X2.2, X3, X4.2 and X5.2 members (Figures 43, 46 and 47). The F2 and F5 faults, the boundary between X4.2 and X5.1 members, the northern limit of the volcanic terrain and the limit of alluvial deposit are the subarea boundaries in the south and southwest. The axial trace of the major overturned syncline and Thap Kwang Thrust were the rest of subarea boundaries in the northwest and northeast. This subarea is further subdivided into three parts, Subareas 4.1., 4.2 and 4.3 by F7 and F8 faults.

The bedding planes mostly trend east-west and southeast-northwest, and incline to the south and southwest directions. The dip values are mostly between 35 and 65 degrees (Plate 1). The

geometric features of associating minor folds are generally characterized by a series of gently plunging, tight to isoclinal overturned with subrounded to subangular hinge area of Z-type (looking west). These folds were clearly exposed at Khao Mai Nuan, Khao Phu Phe and Khao Lom Phat. The detailed study results will be mentioned later.

The stereonet plots of the poles of bedding planes of each member were performed. The result indicated that the bedding planes orientations were generally uniformed, again with the minor lower-order folds and undulating cross folds.

5.2 The Fold Styles in the Entire Study Area

The collective structural data gathered in the subareas were compared. From the field observation, the attitudes of bedding planes are mostly inclined to the south, only few to several other directions. This deformed-rock region is associated with the faults, F1, F2, F3, F4 and F5 normal faults and the left- and right-lateral F6, F7 and F8 strike-slip faults. The interpreted overturned syncline and anticline reigned the area with the fold axes trend approximately southeast/northwest and east/west (Plate 1).

The concentration of the poles of bedding planes as plotted in a lower-hemisphere equal area net points out that the penetrative bedding planes mostly incline to the south with a rather simple maximum concentration as shown in Figure 48. The 3-dimensional structural models hence constructed are also compared in Figure 49.

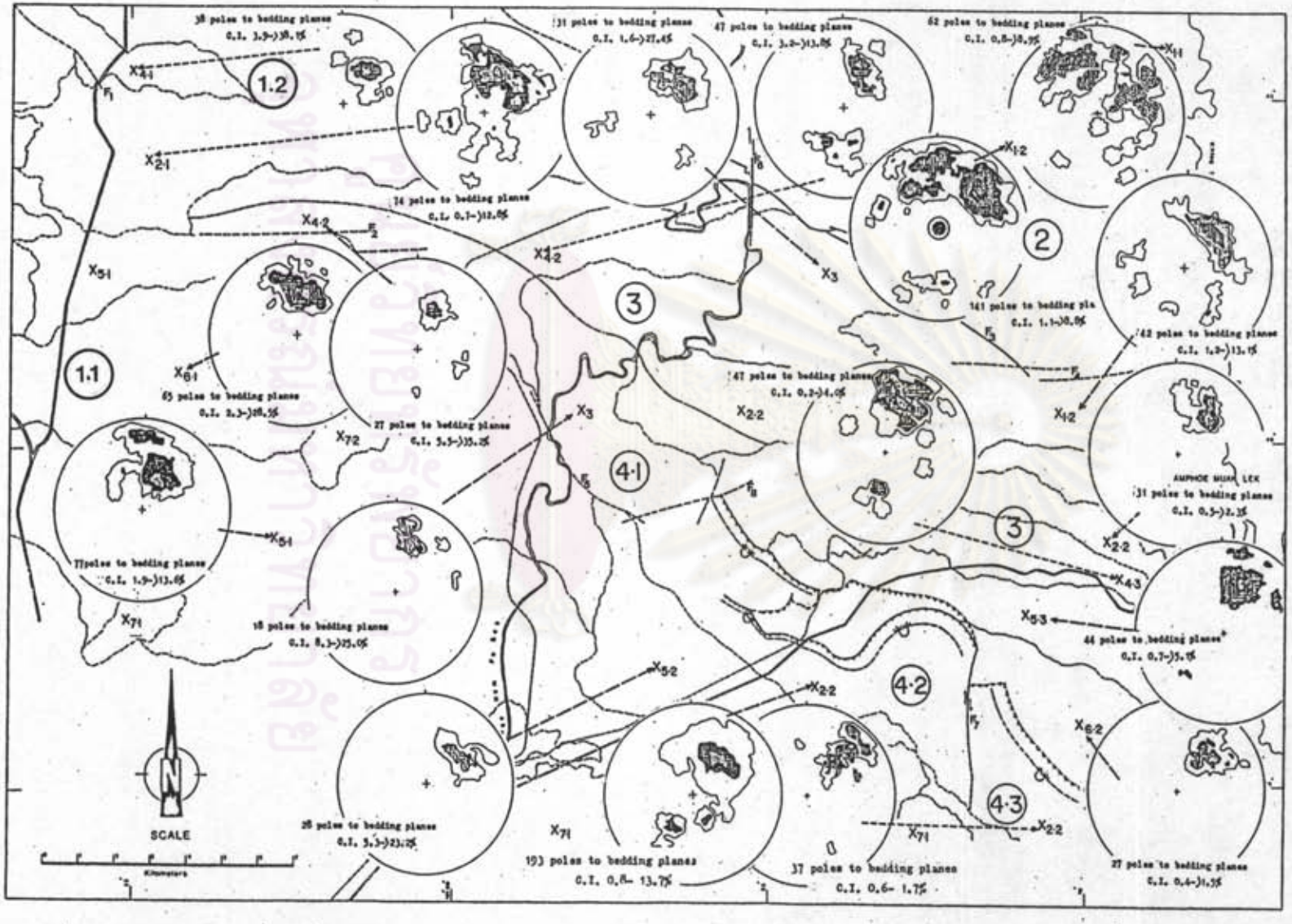

Figure 48 Map showing the study subareas and the ¶-diagrams of the bedding planes.

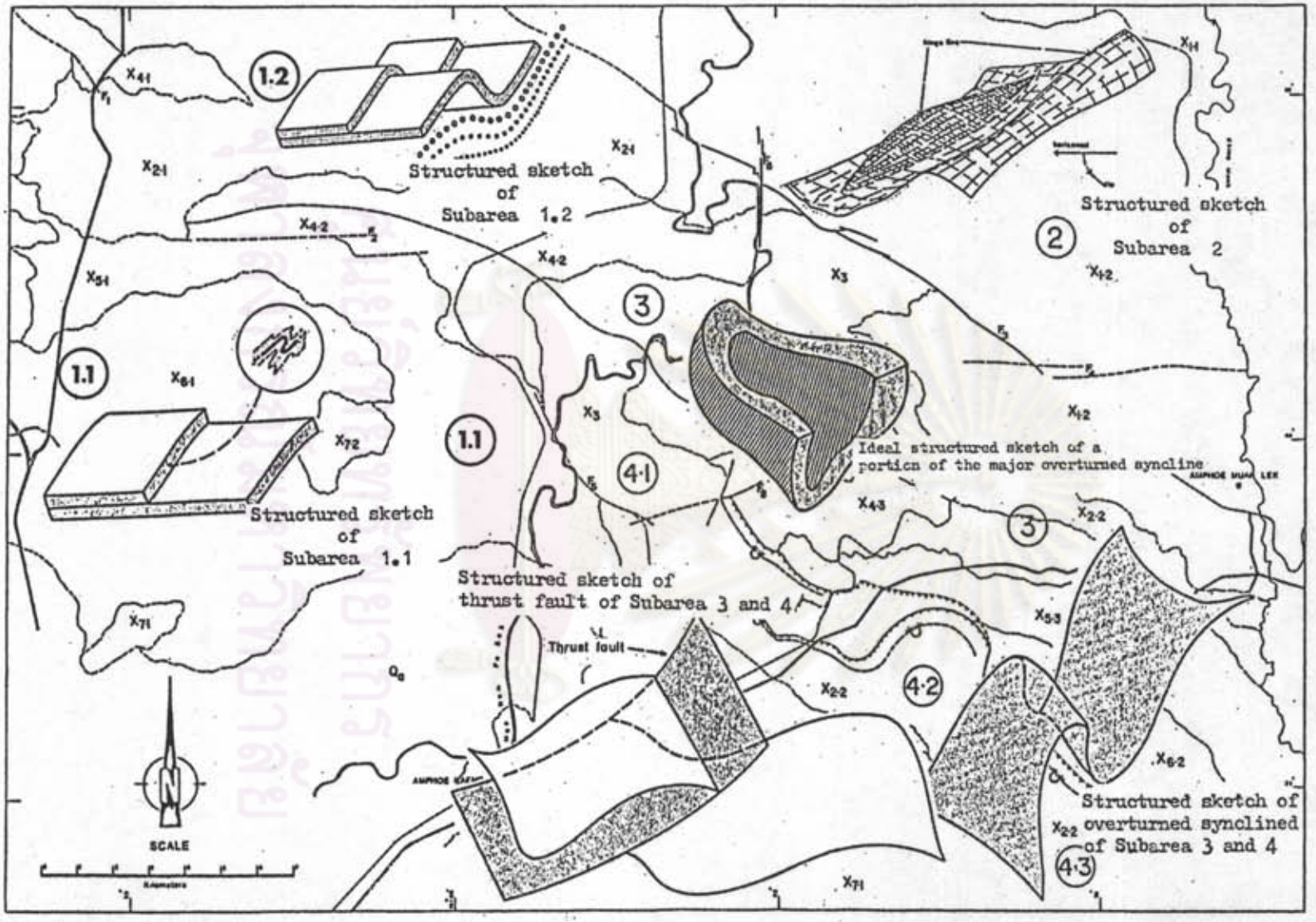

Figure 49 The 3-dimensional structural models of the entire study area.

From the ¶-diagrams of the bedding planes a great circle of the fold profile was approximate in each stereonet plot (Figure 50). As a bedding plane is a primary structure, so termed So (Turner and Weiss, 1963), the pole of the fold profile is the fold axis, termed a βso. The fold axes observed in those ¶-diagrams were then plotted in an equal-area stereonet (Figure 51 a) and the concentration contouring was prepared (Figure 51 b). The contours of concentration illustrated that the fold axes gently plunge to the west, with a variation from the northwest, and gradually plunge steeper to the southwest. The majority of the fold axes plunge gently to mederately to the west, however.

The bedding plane orientation distribution also reveals the hidden undulating upright cross fold system as previously mentioned. The cross folds should be seen as the systematic irregularity (or wiggles) on the generally southerly-dipping fold limbs (normal as well as overturned), with the fold axes closely follow the dip of the limbs.

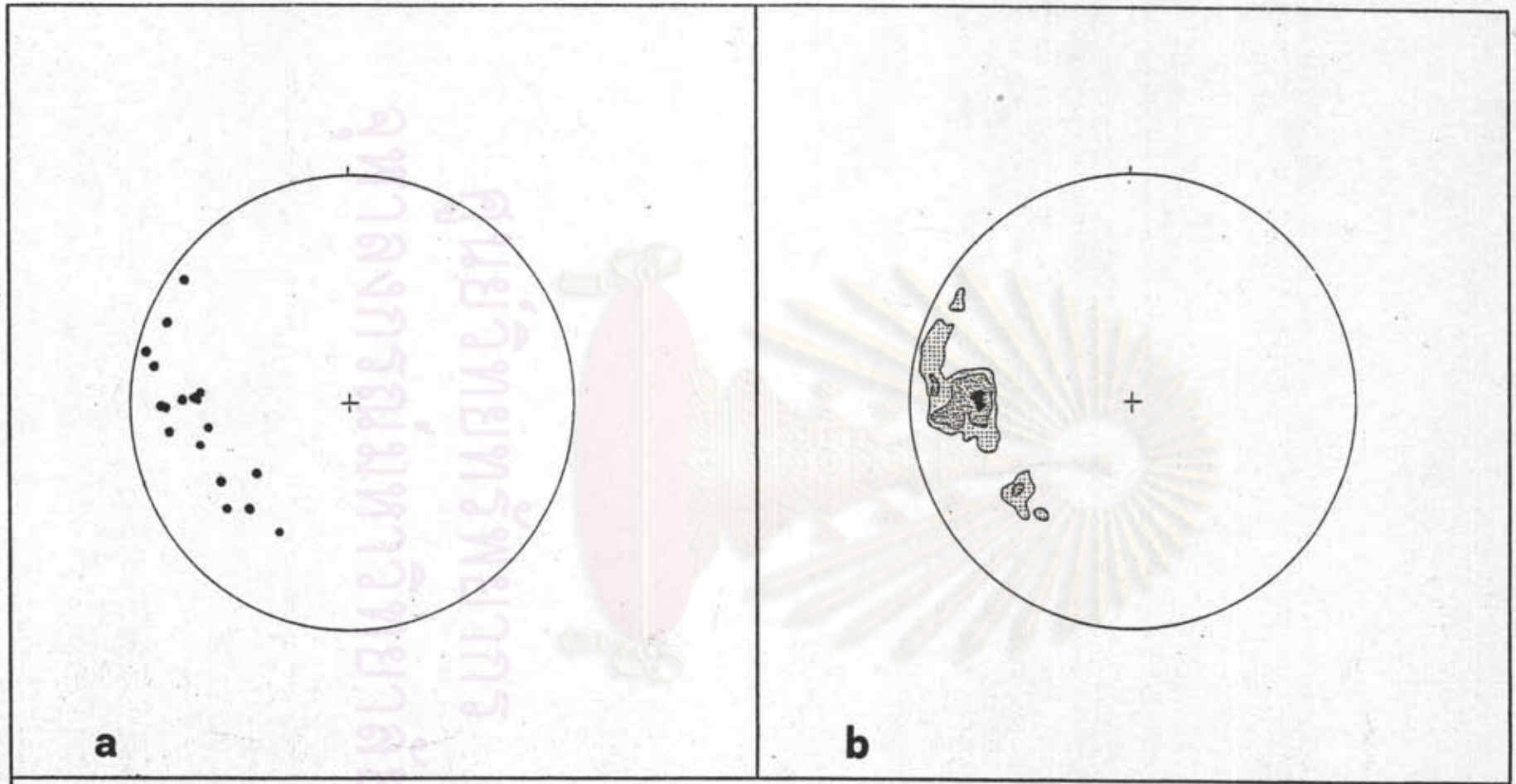

Figure 51 Stereonet plot of βSo (a) and contouring concentration of βSo (b).