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Report F5

Report on soil observations made in Forest Reconnaissance

Inventory Units 1 and 3 in the

UPPER RAJANG BASIN

by

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Report on soil observations made in Forest Reconnaissance Inventory units 1 and 3 in the Upper Rajang Basin

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During 1964 the F.A.C. and the Forest Department carried out reconnaissance forest inventory surveys in the area in the upper Rajang basin. As a parallel, but separate, project the Research Section of the Forest Department examined and sampled the soils of some of the inventory sample sites, in an attempt to clarify relationships between the floristic composition and degree of internal decay of the standing forest and the soil. Maps (in end folder) Although this project was not planned or carried out as a formal soil survey, a substantial

1	Forest inventory units and meteorological stations
2	Unit 1
3	Unit 3. This includes generalised conclusions and 'raw' profile descriptions and analyses, this is essentially an interim report, to be superseded by the results of systematic soil surveys as they are carried out.

Introduction

The Rajang basin upstream of Kapit accounts for about one quarter of the total area of Sarawak. Because of its rugged terrain and difficult communications, it is at present sparsely populated and little developed. Soils data from the area is extremely meagre and is unlikely to be greatly augmented in the near future, because the Soil Survey Division of the Department of Agriculture is fully extended in carrying out pre-development investigations in more accessible parts of the country.

In view of the dearth of soils data from the area, observations made in the course of a forest research project are reported here.

During 1969 the F.A.O. and the Forest Department carried out reconnaissance forest inventory surveys in two areas in the upper Rajang basin. As a parallel, but separate, project the Research Section of the Forest Department examined and sampled the soils of some of the inventory sample sites, in an attempt to clarify relationships between the floristic composition and degree of internal decay of the standing forest and the soil on which it is growing. Although this project was not planned or carried out as a normal soil survey, a considerable amount of soils information was collected, and the density of observations is of the same order as a broad reconnaissance survey.

As it only includes generalised conclusions and 'raw' profile descriptions and analyses, this is essentially an interim report, to be superseded by the results of systematic soil surveys as they are carried out.

Area Map (1-3 years to 1967)

Mean 9 13 16 12 13 9 9 7 9 12 11 10

Notes

- (1) Figures are taken from Hydrological Yearbook 1967-8, and are to the nearest inch.
- (2) These figures are taken from Soil (1958).
- (3) There are no records for completed years for this station.

1 General description of the area

1.1 Climate

The only meteorological stations in the upper Rajang with relatively continuous records covering more than short periods are at Kapit and Belaga. There are other raingauges, including two in Unit 1 (Nanga Merit and Nanga Ebon) and two in Unit 3 (Nanga Gaat and Nanga Entawau) but the data from these stations cover only short and discontinuous periods.

Table 1 summarises the rainfall data from Kapit and Belaga. The means from Nanga Merit are included for comparison.

Table 1

Rainfall in the Upper Rajang Basin

Kapit (25 years to 1968)

	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Mean	15	13	14	12	12	9	8	10	12	14	12	14	143
Maximum	26	29	27	18	17	15	19	20	26	24	18	21	170 ⁽²⁾
Minimum	7	5	5	3	6	4	1	1	6	6	5	8	107 ⁽²⁾

Belaga (12 years to 1968)

Mean	13	14	13	15	11	12	11	8	10	14	13	13	147
Maximum	23	18	23	19	17	23	16	20	18	21	19	18	157 ⁽²⁾
Minimum	6	8	6	9	6	5	4	2	4	8	8	6	130 ⁽²⁾

Nanga Merit (1-3 years to 1967)

Mean	9	13	16	12	13	9	9	7	9	12	11	10	- ⁽³⁾
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Notes:

- (1) Figures are taken from Hydrological Yearbook 1967-8, and are to the nearest inch.
- (2) These figures are taken from Seal (1958).
- (3) There are no records for completed years for this station.

There have been Class A evaporation pans in operation at Kapit and Belaga since 1963. The data from these installations are summarised in Table 2.

Table 2

Evaporation at Kapit and Belaga

	<u>Kapit</u>												Annual
	J	F	M	A	M	J	J	A	S	O	N	D	
Mean	5	5	6	6	6	5	6	6	6	6	6	6	67
Maximum	6	5	11	7	6	6	6	6	6	6	6	6	71
Minimum	4	4	5	4	5	5	5	6	5	5	5	5	62

	<u>Belaga</u>												Annual
	J	F	M	A	M	J	J	A	S	O	N	D	
Mean	6	5	6	6	6	6	5	5	5	6	5	6	67 ⁽²⁾
Maximum	7	6	7	7	6	6	7	6	6	6	6	6	
Minimum	5	4	4	6	5	5	5	5	5	5	5	5	

Notes:

- (1) Figures are taken from the Hydrological Yearbooks 1963-8, and are to the nearest inch.
- (2) There is only one complete year of figures for Belaga.

The data summarised in Tables 1 and 2 are from stations at low altitudes (less than 500 feet). It is known that rainfall increases in quantity and duration with altitude, but the magnitude of this effect is not known. During the 1955 Oxford expedition to the Usun Apau, 91 rainy days were recorded out of a total of 99 (quoted in Kirk, 1957), but the period covered is too short to enable definite conclusions. Also, the recordings were taken during the period of the Northeast monsoon, which is the wettest part of the year.

The evaporation in the montane and high plateau areas is undoubtedly less than at low altitudes, because of the lower temperatures, higher humidities and greater incidence of clouds.

1.2 Geology

The area is mostly underlain by the sedimentary rocks of the Belaga Formation. These cover about 20,000 square miles in Sarawak and also extend over large areas of Kalimantan, where they are known as the Eocene Phyllite Formation (Haile, 1955).

Argillaceous rocks predominate throughout the Formation with intercalated sandstones accounting for 5-35% of the thickness in different parts of the succession. The argillaceous rocks may be slightly metamorphosed, and argillites and phyllites are found. However grey, red and green shales and mudstones are the most common types. The sandstones are of the greywacke and subgreywacke type, and occur as thin beds throughout the succession. There are also massive beds of greywacke, up to 300 feet in thickness. These are of topomorphic importance and are more common in the middle stages (Kirk, 1957; Leichti, 1960).

The rocks were deposited in Late Cretaceous - Paleogene times on the southwest shoulder of the northwest Borneo geosyncline. Since deposition they have been intensely folded and faulted, and vertical or steep angles of dip now prevail. The strike follows a generalised southwest - northeast trend.

The Formation has been subdivided into stages (Kirk, 1957) or members (Leichti, 1960). The main characteristics of these subdivisions are summarised in Table 3.

Stage	Member	Age
Stage I	Leichti member	Late Cretaceous
Stage II	Kapit member	Paleocene - early Eocene
Stage III	Belaga member	Middle - Late Eocene
Stage IV	Belaga member	Late Eocene
	Belaga member (3)	Late Eocene

Table 3
 Summary of the Belaga Formation
 (Kirk, 1957; Leichti, 1960)

Subdivision of the Belaga Formation

Name		Age (Leichti, 1960)	Estimated thickness in feet (Leichti, 1960)	Characteristics of argillaceous rocks	Arenaceous rocks	
Kirk (1957)	Leichti (1960)				Thickness as % of total	Aspect
Stage I	Layar member	Late Cretaceous	8,250 (1)	Black phyllites and slates	(2)	Thin interlayers and very few thick beds.
Stage II	Kapit member	Paleocene - early Eocene	10,900	Red and purple shales. Grey and green slightly phyllitic shales	< 10%	Mostly thin interlayers.
Stage III	Pelagus member	Middle - late Eocene	10,600	Grey shales	ca 35%	Thick beds common. Abun- dant thin interlayers.
Stage IV	Metah member	Late Eocene	4,450	Dark grey and grey carbonaceous shales	(2)	Beds rarely thicker than 3 feet.
	Bawang member (3)	Late Eocene	(4)	Blue grey - black soft slaty shales	< 10% (5)	Thin beds only.

Notes:

- (1) Base not exposed.
(2) No estimates given in Kirk (1957) or Leichti (1960) but thought to be 10-25%.
(3) Bawang member does not outcrop in Rajang basin.
(4) Base not exposed, and no marker beds.
(5) Estimate from qualitative description of Leichti (1960).

The northern part of the catchment of Batang Belaga is underlain by Neogene sediments, which stretch unbroken through the northern Sarawak and Brunei. In addition, there are several outliers of these younger sediments within the main Belaga Formation outcrop. One of these occurs in the southwestern corner of Unit 1. These sediments were laid down in shallow water conditions after the intense deformation of the Belaga Formation. As a result, angular unconformities of up to 90° are common. The deposits are often dominated by sandstones, which are softer, more siliceous, and more gently dipping than those of the Belaga Formation.

There are several areas of volcanic rocks but they are all very inaccessible and there are no outcrops in Units 1 or 3. The rocks are of very recent origin and postdate the Neogene sediments.

1.3 Topography

The landscape of the area is still very juvenile and is subject to strong lithological control. The landforms found on the vertical beds of the Belaga Formation, the shallow dipping beds of the Neogene sediments and the young volcanic rocks are quite distinct, both on the ground and on the aerial photographs.

Within the Belaga Formation, the thick sandstone beds are considerably harder than the predominant shales. This and the vertical dip of the beds gives rise to persistent homoclinal sandstone - cored ridges. The crests of these ridges are more or less concordant rising from about 1,000 feet in the vicinity of Kapit to 2,000-3,000 feet in the border areas. Whether these represent the last remnants of a planed Tertiary erosion surface is problematical. The crests are not at all flattened and the term 'knife edge' is often apt. The soils are deeper than those on the flank slopes (see Table 7) which may indicate greater geomorphic age. Dissection and stream downcutting have been intense and are still actively continuing. The slopes of the ridges are steep, commonly exceeding 40° . The valleys of the minor streams are often cut into the country rock and stony alluvium only occurs in narrow and discontinuous patches.

The low angles of dip in the Neogene sediments give a cuesta landscape as long as there are beds sufficiently hard to form the scarps. However some of the sandstones are rather soft, and scarp and dip slope features are not recognisable over parts of the outcrop. In these areas a low broken landscape is found (Baillie, 1970)

The volcanic rocks are all of recent origin, and give rise to positive relief features. The basalt flows give plateaux such as the Kehabor plateau and Kerapa Pila, which are relatively undissected. The more acid volcanic form more rugged mountain ranges such as the Hose and Nieuwenhuis Ranges.

A continuous but narrow belt of recent and subrecent alluvial deposits is found along the major rivers where their courses are parallel to the regional strike trend, e.g. along the Rajang in Unit I and along the Balleh below Nanga Putai and above Nanga Mengiong in Unit 3. Where the Balleh cuts across the strike (probably along a regional fault) between Nanga Putai and Nanga Mengiong, the banks are steep and rocky, and alluvium is rare.

1.4 Vegetation

As a corollary of the low density of population, the vegetation of the area is relatively undisturbed and over 90% of the area is designated as Dryland Forest in the landuse map (Land and Survey Department, 1966). The remainder consists of secondary growth and hill padi land, and the area of permanent cropping is negligible.

The forest on most of the Belaga Formation rocks is Mixed Dipterocarp Forest. The variations within this forest type and their relations to soils and topography are still being investigated. There are areas of kerangas forest in gently sloping areas on the outcrops of the Neogene siliceous sandstones. There are also intergrades between the kerangas and Mixed Dipterocarp Forest. As the volcanic outcrops invariably form positive relief features, the type of forest found on them is affected by altitude as well as the composition of the rock, and montane and moss forests are found.

There are areas of riverain 'empran' forest on the alluvium along the rivers and larger streams.

15. Previous soil survey coverage

The previous soil surveys carried out in the area are summarised in Table 4. The 1968 national soil map (Sarawak Soil Survey Staff, 1968) is based on these, the data from the Linau-Balui plateau and Kerapa Pila/G. Kajang (Dames, 1962), and the data from the Usun Apau plateau (Beckett and Hopkinson, 1962). The intervening areas were mapped by aerial photograph interpretation.

Table 4

Previous Soil Surveys in the Upper Rajang Basin

Survey	Extent (square miles)	Type of survey and mapping scale	Analytical data	Reference
Kapit - Merit	ca 100	Broad reconnaissance 1:125,000	7 profiles analysed. 1 with sand and clay mineralogical data	Andriesse, 1961
Belaga - Tubau	ca 500	Terrain classification (aerial photograph interpretation only) 1:100,000	-	Scott, 1965
Long Maboh	ca 1	Reconnaissance (aerial photograph interpretation and examination of samples in lab.) No soil map	18 Auger samples from 6 sites	Scott, 1968
Nanga Merit	1	Semi-detailed (extensive field work) 1:10,000	-	Scott, 1969
Pelagus P.F.	ca 30	Reconnaissance (1:50,000)	6 profiles (+ 2 quoted from Andriesse, 1961)	Baillie, 1970

The Malaya auger descriptions and the analyses of the Javett auger samples are not included in this report but are available in Kuching.

2 Field observations

2.1 Distribution

The two forest inventory units were located to cover fairly accessible areas of relatively unexploited forest. Unit 1 lies on either side of the Rajang from the Merit up to Belaga and Unit 3 lies mostly on the True Left (i.e. southern) bank of the Balleh between the Melatai and the Gaat. The location of the units is shown on Map 1.

The inventory sampling points are distributed on an unstratified random basis within each unit. Their locations are shown in Maps 2 and 3. Each sample consists of a cluster of 9 plots. There are laid out on a 3 x 3 grid, with an interval of 4 chains from plot centre to plot centre. The plots are of variable size and shape and include all 'in' trees when scanned with a 10-factor prism at the centre point.

8 samples in Unit 1 and 13 samples in Unit 3 were selected for felling and defect measurement. It was intended to examine and sample the soils from all the defect samples and this was done in Unit 1. In Unit 3 however, the soils of only 11 out of the 13 samples were examined.

2.2 Methods

Because of the variable dimensions of the plots, the soil characteristics used in the soils - forest studies are those of the soil at the centre point. The morphological characteristics were examined with a 2 inch Edelmann auger of 4 feet length. To supplement the auger descriptions profile pits were dug on a number of plots. The descriptions and analyses from these profiles are listed in the Appendix.

For the purposes of the soils - forest study, the soil of each plot was systematically sampled for laboratory analysis. The sampling procedure consisted of collecting 5 subsamples each of the topsoil (0-4 inches) and subsoil (18-22 inches), which were bulked in the field. The samples were collected with a 4 inch Jarrett auger at the centre point and at points 12½ horizontal links (2.5 metres) from the centre point along the major compass axes. If this plan involved sampling in a different landscape facet from that of the centre peg, the subsample was not included in the bulked sample.

The Edelmann auger descriptions and the analyses of the Jarrett auger samples are not included in this report but are available in Kuching.

3 Soils

3.1 Soil classification

3.1.1 General

The system used for classifying the soils according to the auger and profile data is outlined in Tables 5 and 6. It is based on the current Sarawak classification (Sarawak Soil Survey Staff, 1966), with modifications that have been described in detail elsewhere (Baillie, 1970).

3.1.2 Soil depth

The main modification of the current Sarawak system concerns soil depth. As most of the soils are shallow, this feature is of great importance. In the system, the Skeletal soils include all soils in which "an R (hard rock) or C (weathering rock) horizon is present within 10 inches of the base of an O (surface litter or peat) horizon".

Thus the separation of the Skeletal soils depends upon the recognition of an R or C horizon. However it is difficult to distinguish between in situ rock and stony material using the 2 inch Edelman auger. As can be seen from the profiles in the Appendix, soils which are deeper than 10 inches to in situ rock, but which have stony subsoils, are common. Relying only on the auger information, such soils would probably be regarded as Skeletal, whereas the digging of profile pits reveals shallow or stony Red Yellow Podsolics. This difficulty has been circumvented by defining the Skeletal soils in terms of their appearance on augering. Similarly the soils of the Red Yellow Podsollic families are split into shallow and deep phases according to their 'auger depth'. These revised definitions are listed in Tables 5 and 6.

3.2 Soil distribution

3.2.1 General

The rapid rate of landscape dissection means that all but the largest valleys are narrow, so that upland soils are far more extensive than those of the valleys. In discussing their distribution the upland soils are subdivided according to parent material. The distribution of the soils is described in 3.2.2 - 3.2.5 below and summarised in Table 9.

3.2.2 Upland soils on Belaga Formation rocks

This is the most extensive group of soils and probably covers more than 90% of the total area. Because of the steep slopes, shallow soils predominate. The most widespread soils are those of Kapit and Meluan

Table 5

Great Soil Groups in the Upper Rajang Basin

Great soil group	Brief definition	Common parent materials in Upper Rajang	Representative Profiles (see Appendix)
Skeletal	Soils with rock or abundant stones (other than thin stone line) within 10 inches of surface.	All rock types	See Table 6
Red Yellow Podsol	Red, brown and yellow non-skeletal, non-gleyed ⁽¹⁾ soils with definite increase in clay content with depth. Subsoil structure generally weak or moderate sub-angular blocky.	Sedimentary and acid igneous rocks. Older alluvium	
Lateritic	Red, brown or yellow non-skeletal, non-gleyed ⁽¹⁾ soils with subsoil content of Group III elements greater than 25%. Subsoil structure generally moderate crumb or angular blocky.	Basic and intermediate igneous rocks.	-
Grey White Podsol	Grey, white or pale yellow non-skeletal, non-gleyed ⁽¹⁾ soils with definite increase in clay content with depth, and with no illuvial humus pan within 40 inches of surface.	Alluvium with low iron content.	-
Podsol	Non-skeletal, non-gleyed ⁽¹⁾ soil with grey, white, or pale yellow horizon abruptly overlying illuvial humus pan within 40 inches of the surface.	Shallow-dipping siliceous sandstone. Coarse textured alluvium	-
Recent Alluvial	Brown, red or yellow non-gleyed ⁽¹⁾ soils with no consistent increase in clay content with depth.	Recent alluvium	F3R, F3U
Gley	Non-skeletal soils with gleyed horizon within 20 inches of surface.	Alluvium	F3L, F3N

Notes:

- (1) 'Non-gleyed' refers to the top 20 inches only. Soils in these groups may have gleying below this depth.

Table 6

Subdivision of the residual (1) Skeletal and Red Yellow Podsollic Soils derived from sedimentary rocks

Great Soil Group	Family	Family Definition	Phase	Phase Definition	Representative Profiles (see Appendix (2))	
Skeletal	Meluan	Rock or stones are hard and impenetrable by auger within 10 inches of surface.	Light	'Light' - clay content is less than 15%.	AF, AV	
			Heavy			
	Kapit	Rock or stones are soft and can be augered to below 10 inches from surface.	Light	'Heavy' - clay content is greater than 15%.	F, V, Y	
			Heavy			
Red Yellow Podsollic (residual)	Matang	Has a bleached albic A ₂ horizon immediately beneath the surface soil. Generally light textured.	Shallow	'Shallow' - rock or many stones within 20 inches of surface.	(G)	
			Deep			
	Nyalau	No albic A ₂ horizon. Surface texture is sandy loam or lighter and subsoil is no heavier than sandy clay loam.	Shallow	(G) AD, AU		
			Deep			
	Bekenu	No albic A ₂ horizon. Surface texture is sandy loam or heavier and subsoil texture is sandy clay or heavier.	Shallow	H (M)		
			Deep			
	Merit	No albic A ₂ horizon. Surface texture is clay loam or heavier. Subsoil texture is clay.	Shallow	X, AB		
			Deep			
					'Deep' - rock and stone free for at least 20 inches from surface.	AC, AQ, AY
						J, Q, T, AR
						E, S, Z, AA, AL, AN

Notes:

- (1) 'Residual' used in the sense of the 1966 Sarawak Classification. Most of the soils are probably colluvial.
- (2) The full field coding is abbreviated in this column by omitting the F (for Forest Dept.) and 3 (for 3rd Division), so that e.g. F3AK becomes AK.

The predominance of argillaceous rocks in the Formation is reflected by the greater extent of heavy textured soils. Thus of the soils in this group described in the Appendix, 20 are 'heavy' (Merit family or heavy phases of Kapit and Meluan families) as compared to 13 'medium' and 'light' (Bekenu and Nyalau families and the light phase of Kapit family). The crests and upper slopes of the major sandstone - spined strike - aligned ridges often, but not invariably, have a cover of light or medium textured soils. Apart from this, there is no immediately apparent relationship between soil texture and topographic position.

3.2.3 Upland soils on Neogene sediments

These rocks cover only a small fraction of the total area except in the northern part of the Belaga catchment. They differ from the Belaga Formation sediments in that the angles of dip are shallower, the proportion of sandstone is higher and the sandstone may be siliceous. These factors favour the formation of podsoles; and soils of the Podsol and Grey White Podsolitic great soil groups are found. However the most extensive soils on these rocks are those of the Red Yellow Podsolitic group, but the shallow phases are relatively rare in comparison with the Belaga Formation outcrop (Andriessse, 1961; Baillie, 1970).

3.2.4 Upland soils on volcanic rocks

The outcrops of volcanic rocks are not extensive, and they are all remote and inaccessible. However they are of scientific interest and a fair amount of soils data from them has been collected.

Several of the volcanic outcrops are of such recent origin, that the upstanding relief features they form are relatively undissected. Slope gradients on top of these plateaux are gentle and, in combination with the high rainfall and low evapotranspiration of the local climate, give rise to a high proportion of poorly drained soils in the Gley group.

The type of soil found on the better drained sites depends on the composition of the rock. Acid rocks give rise to Red Yellow Podsolitic soils of Abok family and related Skeletal soils. These soils differ from the Red Yellow Podsolitic and Skeletal soils formed on sedimentary rocks in having a higher percentage of Group III elements (mostly in oxide form). Basic rocks give rise to Lateritic and related Skeletal soils (Dames, 1962; Beckett and Hopkinson, 1961).

3.2.5 Valley soils

Because the rapid rate of landscape dissection the valley soils are of very limited extent compared with those of the uplands.

The minor streams are often cut into the country rock and Skeletal soils are widespread. However there are narrow, discontinuous patches of alluvium. This material is often poorly sorted and has a high proportion of rocks and stones. A mixture of Gley, Recent Alluvial and Skeletal soils is found on these deposits. Within the Gley and Recent Alluvial soils, stony and shallow subtypes are common (for further discussion of this, see Baillie (1970)).

The major rivers are often flanked by belts of alluvium, although these are rarely more than $\frac{1}{4}$ - $\frac{1}{2}$ mile wide. The younger deposits are covered with a mixture of Recent Alluvial and Gley soils, which are not as stony as those found along minor streams. On the older deposits, the better drained soils often exhibit an increase in clay content with depth, thus qualifying for the Red Yellow Podsol group (Scott, 1969).

Table 9

Soil distribution in the Upper Rajang basin

Topography/Parent material unit	Main soils (1)
Upland - Belaga Formation sediments	Skeletal - Kapit, Meluan Red Yellow Podsol - Nyalau, Bekenu, Merit, (Matang)
Upland - Neogene sediments	Red Yellow Podsol - Matang, Nyalau, Bekenu Skeletal - Merit, Kapit, Meluan Podsol - Silantek (Grey White Podsol - Saratok)
Upland - volcanic (acid)	Gley - Bijat, Tatau Red Yellow Podsol - Abok Skeletal - Kapit, Meluan
Upland - volcanic (basic)	Gley - Bijat, Tatau Lateritic - Tarat Skeletal - Sedong
All valleys	Skeletal - Meluan, Gaya, Kelupu, Binatang Gley - Bijat, Tatau Recent Alluvial - Seduau, Kayan Red Yellow Podsol - Malang, Semilajau

Notes: (1) Parentheses indicate that the soils of the group or family are thought to be of more limited extent.

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4. Conclusions

The rugged appearance of the area on stereoscopic examination of the aerial photographs is fully confirmed on the ground. As such a large proportion of the area consists of steeply sloping land, agricultural development is likely to be highly localised. Detailed and semi-detailed soil surveys are therefore unlikely to be necessary for most of the area, and will be restricted to tracts of gently graded land. For the remainder, terrain classification by air photograph interpretation and a low density field sampling procedure, preferably of the transect type, will suffice to give an adequate picture of soil distribution.

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Appendix

Soil profile descriptions and analyses

The profiles are listed in alphabetical order of field coding, which is approximately the chronological order of description and sampling. They are described along the lines laid down in the Soil Survey Manual (Soil Survey Staff, 1951). The Munsell system is used for soil colours, which are given for the moisture condition at the time of description.

The chemical and mechanical analyses were carried out at the laboratory of Department of Agriculture's Research Centre at Semongok, using the methods described in Sim (1965).

20-50 cm 10YR 9/6 (yellow) with few fine faint 7.5YR 6/8 (reddish yellow), and 7.5YR 7/1 (light grey) mottles, clay, weak moderate medium subangular blocky with strong continuous clay-skin [2.5Y 6/4 (light yellowish brown)], moist, fine, slightly porous, rare roots, few fine to medium pieces of 7.5YR 5/8 (strong brown), 7.5YR 7/1 (light grey) and 2.5YR 6/2 (pale red) mudstone, few rounded quartz stones, scattered charcoal.

Gradual wavy boundary

20-50 cm 10YR 9/6 (yellow) with few fine faint 7.5YR 6/8 (reddish yellow), and 7.5YR 7/1 (light grey) mottles, clay, weak moderate medium subangular blocky with strong to medium discontinuous clay-skin [2.5Y 6/4 (pale yellow)], moist, fine, slightly porous, roots rare, many coarse angular fragments of grey mudstone with reddish yellow and red alteration colours, few fine rounded quartz stones.

20-50 cm Variably hard to soft mudstone which is grey, yellowish brown, olive yellow and red. Thin interlayers of 2.5Y 7/4 (pale yellow) clay. Clay-skin on cracks in the mudstone.

Depth (cm)	pH	% Org. C	Σ Total N	Conc. N ₂ Extract					Exchangeable in /100mm				
				P	Ca	Mg	K	Group	Ca	Mg	K	Na	CN
				ppm	ppm	ppm	ppm	ppm					
0-10	3.5	2.4	0.28	280	90	2570	5910	8.2	0.2	0.2	0.1	Tr	20.5
10-20	3.9	0.9	0.16	160	110	2690	2770	8.9	0.1	0.2	0.2	0.1	15.9
20-30	4.3	0.5	0.14	140	110	3220	6000	11.6	0.1	0.2	0.1	0.1	13.1
30-40	4.0	0.3	0.12	140	110	3000	6930	11.0	0.1	Tr	0.2	0.1	13.3
40-50	4.0	0.2	0.11	120	110	2900	7190	9.3	0.1	Tr	0.2	0.1	12.5
50-60	4.8	0.3	0.13	120	100	3070	6580	10.2	Tr	Tr	0.1	Tr	13.2

Sample	% of fine earth					Texture
	Coarse sand	Medium sand	Fine sand	Silt	Clay	
1	2.3	2.4	21.7	58.5	12.9	Clay loam
2	1.4	1.8	18.3	58.4	19.1	Clay loam
3	4.1	1.6	14.1	57.4	11.0	Clay
4	3.9	1.6	11.0	59.8	12.5	Clay-silty clay
5	4.6	2.2	14.9	50.9	24.0	Weathering substrate
6	3.7	1.1	18.3	45.7	32.1	do.

Profile F3E

Sarawak classification: G.S.G. Family Merit Phase Deep
 Red Yellow Podsollic
 Location: Plot 4, Sample O44, Unit I. Close to Btg. Rajang, upstream of Punan Ba (see Map 2).
 Topography: Crest of major spur (gradient ca 8°).
 Parent material: Belaga Formation (? Metah member) shale.
 Vegetation: Very old secondary forest with high proportion of geronggang (Cratoxylon arborescens).

½-0 Dark reddish brown litter and fallen leaves.

0-2 10YR 4/4 (dark yellowish brown) with few fine faint 7.5YR 7/8 (reddish yellow) mottles, clay, fine to medium subangular blocky, moist, friable, slightly porous, many roots, scattered charcoal.

Gradual wavy boundary

2-9 10YR 6/8 (brownish yellow) with few fine faint 7.5YR 7/8 (reddish yellow), 2.5Y 7/4 (pale yellow) and very few fine faint 7.5YR N7/ (light grey) mottles, clay, fine medium subangular blocky with weak-medium clayskins [10YR 7/4 (very pale brown)], moist, firm, very porous, few fine to medium rounded pieces of black to light grey shale, scattered quartz, common roots.

Diffuse boundary

9-22 10YR 6/8 (brownish yellow) with few fine faint 7.5YR 6/8 (reddish yellow), and very few fine faint 5Y 7/3 (pale yellow) mottles, clay, weak-moderate medium subangular blocky with strong continuous clayskins [2.5Y 6/4 (light yellowish brown)], moist, firm, slightly porous, rare roots, few fine to medium pieces of 7.5YR 5/8 (strong brown), 7.5YR N7/ (light grey) and 2.5YR 6/2 (pale red) mudstone, few rounded quartz stones, scattered charcoal.

Gradual wavy boundary

22-38 10YR 7/6 (yellow) with few fine faint 7.5YR 6/8 (reddish yellow), and 7.5YR N7/ (light grey) mottles, clay, weak moderate medium subangular blocky with strong to medium discontinuous clayskins [2.5Y 7/4 (pale yellow)], moist, firm, slightly porous, roots rare, many coarse angular fragments of grey mudstone with reddish yellow and red alteration colours, few fine rounded quartz stones.

38-56+ Variably hard to soft mudstone which is grey, yellowish brown, olive yellow and red. Thin interlayers of 2.5Y 7/4 (pale yellow) clay. Thin clayskins on cracks in the mudstone.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III%	Ca	Mg	K	Na	CEC
1	0-2	3.5	2.4	0.28	210	90	2370	4910	8.2	0.2	0.2	0.3	Tr	20.3
2	3-6	3.9	0.9	0.16	160	110	2640	5370	8.9	0.1	0.2	0.2	0.1	15.9
3	14-17	4.3	0.6	0.14	140	110	3220	6000	11.6	0.1	0.2	0.1	0.1	13.1
4	26-29	4.6	0.3	0.12	140	110	3000	6930	11.0	0.1	Tr	0.2	0.1	13.3
5	44-56	4.9	0.2	0.11	120	110	2900	7190	9.3	0.1	Tr	0.2	0.1	12.5
6	44-56	4.8	0.3	0.13	120	100	3070	6680	10.2	Tr	Tr	0.1	Tr	13.2

Sample	% of fine earth					Texture
	Coarse sand	Medium sand	Fine sand	Silt	Clay	
	1	2.3	2.4	21.7	38.5	
2	1.4	1.8	18.8	38.4	39.1	Clay loam
3	4.1	1.6	14.1	37.4	41.0	Clay
4	3.5	1.6	11.0	37.9	42.3	Clay-silty clay
5	4.6	2.2	14.9	50.9	24.0	Weathering mudstone
6	3.7	1.1	16.8	45.7	32.1	-do-

Profile F3F

Sarawak classification: G.S.G. Family Phase
 Skeletal Kapit Light
 Location: Plot 3, Sample 044, Unit 1. South of Btg. Rajang
 (see Map 2).
 Topography: Upper slope of major spur.
 Parent material: Belaga formation (Pelagus member) shale.
 Vegetation: Old secondary forest (high proportion of geronggang).

- 2-0 Reddish brown litter. Mostly roots; no leaf laminae except at surface.
- 0-3 Mixed faint 10YR 4/3 (brown) and 10YR 3/4 (dark yellowish brown), fine sandy loam, weak fine subangular blocky breaking to weak fine crumb, moist, friable, porous, roots abundant, common fine charcoal.
- A 1
- Gradual wavy boundary
- 3-9 10YR 7/8 (yellow) with many fine very faint 7.5YR 7/8 (reddish yellow) and few fine faint pale yellow mottles, fine sandy clay loam to fine sandy loam, very weak medium subangular blocky breaking to weak fine subangular blocky with very weak discontinuous clayskins of same colour as matrix, moist, friable, very porous, few pieces of hard pinkish yellow sandstone, many roots.
- Gradual wavy boundary
- 9-36 Abundant pale reddish yellow and pale yellow medium pieces of sandstone set in 7.5YR 7/8 (reddish yellow) sandy clay loam, moderate fine subangular blocky to angular blocky with moderate continuous clayskins especially against stones, moist, friable, porous, few roots.
- B
- Clear regular wavy boundary
- 36-49+ Hard, medium to fine pinkish yellow sandstone, 60° dip.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III %	Ca	Mg	K	Na	CEC
1	0-3	3.4	3.9	0.29	140	310	560	1180	4.1	0.2	0.2	0.2	0.2	15.3
2	4-8	4.0	0.5	0.09	80	200	730	2030	6.7	0.2	Tr	Tr	Tr	5.6
3	20-24	4.6	0.1	0.04	70	200	970	2550	7.9	0.1	Tr	Tr	0.1	5.5
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample 1					1.5	6.1	39.9	15.3	20.4	Sandy clay loam				
2					1.2	5.1	56.5	15.8	16.0	Sandy loam				
3					1.8	4.4	56.9	16.4	16.8	Stony sandy loam				

Profile F3G

Sarawak classification: G.S.G. Family Phase
 Red Yellow Podsollic Nyalau (Matang) Shallow
 Location: Plot 9, Sample 044, Unit 1. South of Btg. Rajang.
 Topography: Lower slope of major spur (gradient ca 11°).
 Parent material: Belaga Formation (Pelagus member) sandstone.
 Vegetation: Old secondary forest (high proportion of geronggang).

- ¼-0 Reddish brown root litter.
- 0-2 10YR 5/3 (brown) with many medium distinct 10YR 6/2 (light brownish grey) and few fine faint 10YR 8/6 (yellow) mottles, medium sandy loam, weak medium subangular blocky, moist, friable, slightly porous, roots abundant, few charcoal.
A1
- 2-8 10YR 8/6 (yellow) with many coarse - medium distinct - prominent 10YR 6/1 (light grey), 2.5Y 6/2 (light brownish grey), 7.5YR 7/8 (reddish yellow) and 10YR 6/2 (light brownish grey) mottles, medium sandy clay loam, weak medium angular blocky, moist, firm, roots rare.
A2
 Clear wavy boundary
- 8-18 10YR 8/6 (yellow) with few fine faint 10YR 7/1 (light grey), many medium distinct 10YR 6/3 (pale reddish yellow), and few fine distinct 7.5YR 7/8 (reddish yellow) mottles, medium sandy loam (to sandy clay loam), weak medium subangular blocky, moist, slightly firm, slightly porous, very few roots, few fine pieces of reddish brown sandstone.
B
 Clear wavy boundary
- 18-31 2.5Y 8/4 (pale yellow) with few fine faint 10YR 7/1 (light grey) and 10YR 8/8 (yellow) mottles, medium sandy loam to sandy clay loam, structure dominated by stones, with weak discontinuous clayskins next to stones, moist, slightly firm, slightly porous, abundant angular and subangular pieces of sandstone, rare roots.
 Clear wavy boundary
- 31-52+ Hard pale yellow, light grey sandstone with patches of orange and reddish brown colours, becomes softer below 47 inches.
 Gradual wavy boundary

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III%	Ca	Mg	K	Na	CEC
1	0-2	3.8	1.0	0.10	70	100	670	1670	2.3	0.2	0.1	0.1	0.1	7.4
2	4-7	4.1	0.3	0.05	60	100	730	1940	3.1	0.1	Tr	Tr	0.1	5.9
3	11-15	4.4	0.2	0.04	60	340	880	2520	5.6	0	Tr	Tr	0.1	5.2
4	22-26	4.6	0.1	0.05	50	100	910	3020	5.3	0.2	Tr	Tr	0.1	4.2

Sample No.	% of fine earth					Texture
	Coarse sand	Medium sand	Fine sand	Silt	Clay	
	1	0.7	1.3	63.1	17.2	9.3
2	0.5	6.5	63.9	15.4	13.6	Sandy loam
3	0.7	5.8	60.3	16.0	17.5	Sandy loam
4	1.3	8.7	47.7	14.7	12.5	Sandy loam

Sample 1	0.7	1.3	63.1	17.2	9.3	Sandy loam
2	0.5	6.5	63.9	15.4	13.6	Sandy loam
3	0.7	5.8	60.3	16.0	17.5	Sandy loam
4	1.3	8.7	47.7	14.7	12.5	Sandy loam

Profile F3H

Sarawak classification: G.S.G. Family Phase
 Red Yellow Podsollic Nyalau Deep
 Location: Plot 7, Sample 054, Unit 1. Sg. Asi area, West of
 Sg. Ba (see Map 2).
 Topography: Lower slope in broken low hilly area (gradient ca 30°).
 Parent material: Belaga formation (Metah member) sandstone.
 Vegetation: Mixed Dipterocarp Forest.

- ½-0 Dark reddish brown litter and roots.
- 0-2
 A1 10YR 5/8 (yellowish brown) with few fine faint 7.5YR 5/8 (strong brown), 7.5YR 7/8 (reddish yellow), 7.5YR N7/ (light grey) mottles, medium sandy loam, very weak fine subangular blocky, moist, friable, slightly porous, abundant roots, much fine quartz.
- 2-12
 A2 Gradual regular boundary
 7.5YR 7/8 (reddish yellow) with many medium distinct 2.5Y N7/ (light grey), 7.5YR 6/8 (reddish yellow), 7.5YR 5/8 (strong brown) and few fine distinct 2.5Y 7/4 (pale yellow) mottles, medium sandy loam, weak to moderate medium subangular blocky with very weak [10YR 5/6 (yellowish brown)] clayskins along root channels, moist, firm, slightly porous, many roots, scattered fine quartz.
- 12-21
 B Gradual wavy boundary
 10YR 7/8 (yellow) with many medium distinct 5Y 8/3 (pale yellow), few fine faint 7.5YR 7/8 (reddish yellow) mottles, medium sandy loam to medium sandy clay loam, moderate medium to coarse subangular blocky, with weak continuous clayskins [10YR 5/8 (yellowish brown)], moist, firm, slightly porous, few roots, much fine quartz.
- 21-32
 Gradual regular boundary
 10YR 7/8 (yellow) with few fine distinct 5Y 8/4 (pale yellow), 7.5YR 5/8 (strong brown), 10R 4/8 (red), 2.5YR 5/4 (reddish brown), 2.5Y 5/6 (light olive brown) and many distinct 7.5YR N5/(grey) mottles, medium sandy clay loam, moderate medium subangular blocky with moderate to weak discontinuous clayskins [10YR 6/8 (brownish yellow)], moist, firm, slightly porous, very few roots, much fine quartz, many soft pieces of weathering sandstone.
- 32-45+
 Clear gradual boundary
 Hard grey, red, light olive brown and strong brown sandstone, with thin interlayers of yellow sandy clay.

Sample no.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III%	Ca	Mg	K	Na	CEC
1	0-2	3.4	1.5	0.14	100	100	1390	2180	4.2	0.1	0.1	0.2	0.3	10.7
2	6-8	3.9	0.6	0.07	40	200	1150	2330	5.1	0.1	Tr	0.1	0.1	8.2
3	14-17	4.3	0.4	0.07	30	210	1620	3540	7.3	0.1	Tr	0.1	0.1	8.9
4	23-26	4.5	0.2	0.03	40	60	1770	4280	7.8	0.3	Tr	0.1	0.1	7.9
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay	Texture				
Sample 1					8.6	14.1	36.5	20.9	16.7	Sandy loam				
2					9.5	12.5	37.5	17.9	17.8	Sandy loam				
3					8.0	12.4	35.1	17.2	27.7	Sandy clay loam				
4					17.8	19.2	14.0	21.9	14.0	Sandy clay loam				

Profile F3J

Sarawak classification: G.S.G. Family Merit Phase Shallow
 Red Yellow Podsollic
 Location: Plot 4, Sample O54, Unit 1. Sg. Asi area, west of Sg. Ba
 (see Map 2).
 Topography: Midslope on intermediate ridge (gradient ca 20°).
 Parent material: Belaga formation (Metah member) shale and sandstone.
 Vegetation: Mixed Dipterocarp Forest.

- ¼-0 Dark brown to reddish brown root litter.
- 0-2 Mixed faint 10YR 6/4 (light yellowish brown) and 10YR 6/6 (brownish yellow), clay loam (to sandy clay loam), moderate medium subangular blocky breaking to moderate - strong fine granular, moist, firm, slightly porous, many roots.
- 41
- 2-6 Gradual regular boundary
 7.5YR 7/8 (reddish yellow) with many medium distinct 2.5Y 7/2 (light grey), 2.5Y 7/4 (pale yellow) and few fine distinct reddish yellow mottles, clay loam, moderate medium subangular blocky with moderate discontinuous clayskins [10YR 6/4 (light yellowish brown)], moist to dry, firm, slightly porous, many roots.
- A2
- 6-13 Gradual wavy boundary
 10YR 7/8 (yellow) with common faint, medium to fine 2.5Y 8/4 (pale yellow) mottles, clay loam to clay, moderate medium subangular blocky with moderate to strong continuous clayskins [10YR 6/4 (light brown)], moist to dry, firm to slightly hard very porous, common roots rare fine, scattered pieces of soft weathering shale.
- B
- 13-24 Gradual wavy boundary
 Colours are as above, stony clay, structure dominated by stones, clayskins as above, firm, roots rare, stones are mostly mixed hard and soft fine pieces of red - dark red and cream shale.
- 24-29+ Diffuse boundary
 Mixed hard and soft weathering shale. Colours are as above plus yellow with interstitial fine patches of light yellow clay, structure dominated by stones.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III %	Ca	Mg	K	Na	CEC
1	0-2	3.8	1.9	0.19	100	100	1710	4070	6.0	0.2	0.5	0.3	0.1	14.0
2	2-6	3.7	1.2	0.14	80	Tr	1940	4520	6.1	Tr	0.2	0.2	0.1	13.2
3	8-11	4.4	0.5	0.08	70	310	2100	5340	9.6	0.4	0.1	0.2	0.1	16.4
4	17-20	4.7	0.3	0.07	40	180	2220	7970	11.0	0.2	Tr	0.2	0.1	10.0
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample 1					6.5	7.9	27.2	31.4	27.7	Clay loam				
2					4.2	5.3	29.3	34.2	29.1	Clay loam				
3					3.5	3.5	23.3	29.3	39.2	Clay				
4					3.8	2.7	23.0	41.3	29.0	Stony clay loam				

Profile F3K

Sarawak classification: G.S.G. Family Skeletal Phase Heavy
 Location: Plot 2, Sample 054, Unit 1. Sg. Asi area, west of Sg. Ba (see Map 2).
 Topography: Lower slope of minor spur (gradient ca 25°).
 Parent material: Belaga formation (Metah member) sandstone.
 Vegetation: Mixed Dipterocarp Forest.

1-0 Dark brown litter and roots.

0-2 10YR 6/8 (brownish yellow) with few fine faint 2.5Y 7/6 (yellow), 7.5YR 7/8 (reddish yellow), and many medium distinct 10YR 5/4 (yellowish brown) mottles, medium sandy clay loam, very weak fine subangular blocky, moist, friable, slightly porous, abundant roots.

Gradual regular boundary

2-12 Thick stoneline of bluish grey, light olive, yellowish brown, and strong brown sandstone. Thin interlayers of 7.5YR 7/8 (reddish yellow) medium sandy clay to sandy clay loam.

12-47 7.5YR 7/8 (reddish yellow) with few fine faint 5Y 8/4 (pale yellow) mottles, medium sandy clay, moderate coarse subangular blocky with weak medium continuous clayskins [10YR 7/6 (yellow)], moist, firm, slightly porous, few roots, many coarse hard angular pieces of light yellow, grey, brown and strong brown sandstone, many medium patches soft red and yellow of weathering sandstone, rare fine quartz.

Clear gradual boundary

47-60+ Hard stones of red, grey, blue, yellow sandstone with small interstitial patches of 7.5YR 7/8 (reddish yellow) and few fine faint 5YR 5/6 (yellowish red) and 5Y 8/4 (pale yellow) mottles, sandy clay.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III %	Ca	Mg	K	Na	CEC
1	0-2	3.9	1.2	0.12	80	100	1220	2440	6.9	0.2	0.1	0.2	0.1	6.0
2	20-23	4.5	0.2	0.04	50	100	1700	3400	9.5	Tr	Tr	0.1	0.1	15.0
3	36-39	4.8	0.1	0.03	40	120	1730	3210	9.7	Tr	Tr	0.1	0.1	11.2
4	55-60	5.3	0.1	0.02	40	100	1220	3550	9.9	0.1	Tr	0.1	0.2	5.7
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample 1					8.1	11.5	34.8	21.3	22.7	Sandy clay loam				
2					8.2	11.8	34.7	11.0	29.3	Sandy clay loam				
3					9.1	11.9	32.7	12.8	29.1	Sandy clay loam				
4					19.6	19.9	27.4	10.1	18.6	Stony sandy loam				

Profile F3M

Sarawak classification: G.S.G. Family Phase
 Red Yellow Podsollic Nyalau (Matang) Deep
 Location: Plot 6, Sample O74, Unit 1. Ulu Ba (see Map 2).
 Topography: Crest of lower end of minor spur (gradient ca 10°).
 Parent material: Belaga formation (Metah member), mixed sandstone and shale.
 Vegetation: Mixed Dipterocarp Forest.

- ½-0 Dark reddish brown litter and roots.
- 0-2 10YR 5/4 (yellowish brown) with many distinct 7.5YR 4/2 (dark brown), 5Y 6/1 (grey), few fine faint 10YR 5/1 (grey), 5YR 4/8 (yellowish red) and 7.5YR 7/8 (reddish yellow) mottles, medium sandy loam, weak fine subangular blocky, moist, friable, slightly porous, many roots.
 A1
- 2-10 Clear gradual boundary
 7.5YR 7/8 (reddish yellow) with many coarse medium distinct 5Y 6/1 (grey), 2.5Y N7/ (light grey), few fine faint 2.5Y 7/6 (yellow), and 2.5Y 5/2 (greyish brown) mottles, medium sandy loam, moderate medium - coarse subangular - angular blocky, moist, firm, slightly porous, common roots.
 A2
- 10-23 Gradual wavy boundary
 10YR 7/8 (yellow) with many fine distinct 7.5YR N7/ (light grey), 7.5YR 7/8 (reddish yellow) and 5Y 7/4 (pale yellow) mottles, medium sandy loam to medium sandy clay loam, moderate medium to coarse subangular blocky with weak moderate continuous clayskins [10YR 7/4 (very pale brown) 7, moist, firm, slightly porous, few roots, few patches of soft, 5YR 4/6 (yellowish red) weathering sandstone.
 B
- 23-30 Diffuse boundary
 2.5Y 7/4 (pale yellow) with many medium distinct 2.5Y N7/ (light grey) and 7.5YR 6/8 (reddish yellow) mottles, medium sandy clay loam, moderate medium subangular blocky with strong continuous clayskins [2.5Y 6/4 (light yellowish brown) 7, moist, firm, slightly porous, rare roots, few soft pieces of 5YR 4/6 (yellow red) weathering sandstone.
- 30-36 Gradual wavy boundary
 Colour, mottles, texture, structure, clayskins, and consistence are as above, plus many hard pieces of 7.5YR 4/2 (dark brown) and 7.5YR 7/8 (reddish yellow) mudstone, plus many soft patches of 2.5Y 4/2 (dark greyish brown), 10YR 5/3 (brown), 7.5YR 5/6 (strong brown), 5YR 5/3 (reddish brown) weathering mudstone, plus few patches of soft 5YR 4/8 (yellowish red) weathering sandstone.
- 36-46+ Gradual wavy boundary
 Hard grey, red and brown mudstone.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III %	Ca	Mg	K	Na	CEC
	0-2	3.9	1.6	0.16	160	100	720	1610	1.8	0.3	0.3	0.2	0.1	5.1
	5-8	4.1	0.3	0.06	100	100	910	2520	3.7	0.2	0.1	0.1	0.1	4.8
	13-15	4.5	0.2	0.05	110	360	990	2670	4.9	0.4	0.1	0.1	0.1	5.4
	24-26	4.6	0.1	0.05	120	200	1150	3200	4.1	0.2	0.1	0.1	0.1	5.2
	32-36	4.3	0.2	0.07	150	100	1520	3940	7.3	0.2	0.2	0.1	0.1	6.4
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample 1					2.3	13.7	55.2	12.2	14.3	Sandy loam				
2					1.1	12.2	54.8	12.5	17.6	Sandy loam				
3					1.1	10.1	53.6	15.4	19.5	Sandy loam				
4					1.3	10.9	49.7	14.9	21.4	Sandy clay loam				
5					3.6	7.2	37.4	19.1	27.5	Sandy clay loam				

Profile F3N

Sarawak classification: G.S.G. Family
 Gley Bijat
 Location: Plot 9, Sample O74, Unit 1. Ulu Ba (see Map 2).
 Topography: Narrow floodplain of minor stream (zero gradient).
 Parent material: Recent alluvium derived from Belaga Formation.
 Vegetation: Empran forest.

0-3 10YR 4/3 (brown - dark brown) with few medium distinct 2.5Y 6/4 (light yellowish brown) and 7.5YR 5/8 (strong brown) mottles, silty clay loam, very weak fine subangular blocky, moist to wet, plastic, sticky, non-porous, abundant roots, much fine charcoal.

Clear regular boundary

3-11 Mixed 2.5Y 6/4 (light yellowish brown) and 2.5 N7/ (light grey) with many prominent medium 5YR 6/8 (reddish yellow) and 5YR 4/6 (yellowish red) mottles (mostly mottles are tubular and along old root channels), silty clay to silty clay loam; moderate to weak medium subangular blocky, moist, firm, slightly sticky, plastic, slightly porous, many roots.

Gradual regular boundary

11-25 2.5Y N5/ (grey) with many medium faint 5Y 7/4 (pale yellow), common fine distinct 10YR 6/6 (reddish yellow) and 10YR 5/4 (yellowish brown) mottles, silty clay to clay, massive, wet, sticky, plastic, non-porous, few roots.

Clear regular boundary

25-32+ 2.5Y N3/ (very dark grey) mudstone with many reddish brown and orange mottles along bedding planes, very wet below 32 inches.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III %	Ca	Mg	K	Na	CEC
	0-3	4.1	5.4	0.38	320	950	2770	3860	8.3	2.4	1.7	0.4	0.2	14.5
	5-9	4.2	0.5	0.12	170	150	2960	4530	10.2	0.5	1.3	0.2	0.1	8.8
	17-21	4.8	0.5	0.11	190	200	3750	4420	10.4	1.0	1.9	0.2	0.1	9.9
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay	Texture				
	Sample 1				1.0	0.6	8.6	36.9	26.9	Silty clay loam - clay loam				
	2				0.4	0.3	17.4	40.6	34.7	-do-				
	3				1.5	1.1	16.2	42.0	32.5	-do-				

Profile F3P

Sarawak classification: G.S.G. Family Phase
 Skeletal Kapit Heavy
 Location: Plot 2, Sample 074, Unit 1. Ulu Ba area (see Map 2)
 Topography: Lower slope in undulating terrain (gradient ca 30°).
 Parent material: Belaga formation (Metah member) shale.
 Vegetation: Mixed Dipterocarp Forest.

0-5 10YR 6/8 (brownish yellow) with few fine faint 2.5Y 6/2 (light brownish grey) and 7.5YR 6/8 (reddish yellow) mottles, clay, weak fine to medium subangular blocky, moist, slightly firm, slightly porous, many roots, many pieces of soft grey, brown mudstone and few pieces of hard black ironcoated mudstone.

A1

Diffuse boundary

5-11 Colour and texture as above, structure dominated by stones, moist, slightly firm, non porous, roots common, stones as above, but increase to abundant.

Gradual wavy boundary

11-46 10YR 6/8 (brownish yellow) with few fine faint 2.5Y N7/ (light grey) mottles, soft mudstone with patches of interstitial clay, structure dominated by stones with strong continuous clayskins [2.5Y 7/4 (pale yellow)] against stones, moist, firm, slightly sticky, plastic, non porous, roots rare. Mudstone is fairly hard with red, brown, yellow, grey and black colours.

B

(sample 3)

Diffuse boundary

46-64+ As above but patches of interstitial clay decrease in size and frequency.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III %	Ca	Mg	K	Na	CEC
	0-5	4.1	1.5	0.21	280	100	3190	4900	11.8	0.4	0.1	0.2	0.1	9.2
	5-8	4.2	0.8	0.17	240	110	3810	6980	14.3	0.2	0.7	0.1	0.1	11.3
	20-23	4.8	0.2	0.12	180	210	4070	6880	13.8	0.2	0.7	0.1	0.1	13.1
	40-44	4.9	0.2	0.12	220	310	5220	7140	13.0	0.3	1.4	0.1	0.1	11.7
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
	Sample 1				10.6	2.7	13.7	36.0	30.9	Clay loam				
	2				6.6	2.2	10.4	41.5	36.3	Clay loam				
	3				7.1	2.3	8.9	45.5	33.1	Weathering shale				
	4				10.4	2.3	9.0	47.4	27.7	Weathering shale				

Profile F3Q

Sarawak classification: G.S.G. Family Phase
 Red Yellow Podsollic Merit Shallow

Location: Plot 3, Sample 074, Unit 1. Ulu Ba area (see Map 2).
 Topography: Lower slope in low undulating terrain (gradient ca 30°).
 Parent material: Belaga formation (Metah member) sandstone.
 Vegetation: Mixed Dipterocarp Forest.

- 0-5 Mixed faint 10YR 6/4 (light yellow brown) and 10YR 6/6 (brownish yellow) with many medium faint 10YR 3/2 (dark brown) mottles, clay loam, moderate medium subangular blocky, moist, firm, porous, abundant roots.
 A1
- Clear regular boundary
- 5-12 10YR 6/6 (brownish yellow) with few fine very faint, 10YR 7/4 (very pale brown) and 7.5YR 5/8 (strong brown) mottles, clay loam, moderate medium subangular blocky with moderate continuous clay-skins [10YR 6/4 (light yellowish brown)], moist, very firm, many roots, scattered pieces of soft, grey and purple mudstone.
 B
- Gradual regular boundary
- 12-29 10YR 6/4 (light yellowish brown) with few fine very faint reddish yellow mottles, gritty clay loam, structure dominated by stones with moderate discontinuous clayskins [10YR 6/4 (light yellowish brown)], moist, firm, slightly porous, few roots, abundant pieces of purple and brown weathering mudstone with many patches of yellow, red and grey, common hard pieces of black ironcoated mudstone.
- Diffuse boundary
- 29-42+ In situ weathering mudstone, colours very varied, mostly purple and brown, but pale yellow, reddish yellow, light grey and red colours common, occasional patches of black iron deposition.

Sample no.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III %	Ca	Mg	K	Na	CEC
1	1-4	3.8	2.1	0.25	400	320	3120	6710	13.6	0.7	1.0	0.5	0.1	14.4
2	7-10	4.1	0.8	0.17	310	210	3840	6940	15.8	0.3	0.4	0.3	0.1	12.9
3	18-22	4.7	0.3	0.12	270	170	4780	6860	13.6	0.1	0.5	0.1	0.1	13.1
4	36-40	5.5	0.2	0.11	340	110	5470	7100	14.8	0.2	1.5	0.4	0.7	16.8
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample 1					8.7	4.2	10.6	42.6	36.7	Silty clay loam				
2					6.4	2.3	9.4	40.5	40.0	Silty clay loam				
3					8.5	2.1	5.7	46.6	33.7	Stony silty clay loam				
4					21.7	3.1	0.8	46.1	26.3	Weathering shale				

Profile F3R X

Sarawak classification: G.S.G. Family
Recent Alluvial Soil Seduau
Location: Plot 4, Sample O24, Unit 1. South of Batang Rajang
(see Map 2).
Topography: Floodplain of minor stream (zero gradient).
Parent material: Recent alluvium derived from Belaga formation.
Vegetation: Secondary forest.

- ½-0 Litter and root mat.
- 0-1 Mixed 10YR 5/3 (brown), 10YR 6/4 (light yellowish brown), 2.5Y 7/2 (light grey) and 7.5YR 5/6 (reddish yellow), clay loam, very weak medium granular, moist-wet, friable, non porous, abundant roots.
- 1-5 Clear regular boundary
10YR 7/4 (very pale brown) with abundant fine very faint 10YR 6/4 (light yellowish brown) mottles, clay loam, moderate fine sub-angular blocky with moderate very discontinuous clayskins especially in old root channels, [mostly light yellowish brown 10YR 6/4], moist, slightly friable, non porous, many roots.
- 5-12 Gradual regular boundary
Mixed faint 2.5Y 8/4 (pale yellow), 10YR 7/4 (very pale brown) and 7.5YR 7/8 (reddish yellow), clay to silty clay, moderate coarse subangular blocky, with moderate continuous clayskins [10YR 6/4 (light yellowish brown)], moist, firm, slightly plastic, slightly porous, few roots.
- 12-20 Gradual regular boundary
Mixed 2.5YR 6/8 (light red) and 2.5Y 8/8 (yellow), clay, weak fine subangular blocky to massive, moist, firm, plastic, slightly sticky, non porous, roots rare.
- 20-25 Gradual wavy boundary
Mixed faint 2.5Y 8/4 (pale yellow) and 2.5Y 7/4 (pale yellow) with many fine very faint reddish yellow and yellow mottles, sandy clay, massive, wet, sticky, plastic, many roots. This grades laterally into 2.5N 7/ (very light grey) with many prominent medium 10YR 7/8 (reddish yellow) mottles, coarse sandy clay loam, very weak coarse subangular blocky - massive, wet, firm, sticky, plastic, many rounded quartz pebbles.
- 25-29 Clear irregular boundary
2.5Y N7/ (light grey) with common faint medium 7.5Y 6/4 (light yellow brown) and few medium distinct strong brown mottles, loamy coarse sand to coarse sandy loam, massive, wet, slightly sticky, plastic, roots rare, many stones - mostly subangular quartz.
- 29-34 Clear irregular boundary
Mixed faint 2.5Y N6/ (grey) 2.5Y N4/ (dark grey) with few coarse prominent strong brown mottles, clay loam, massive, wet, sticky, plastic, abundant pieces of light grey weathering shale, roots absent.
- 34-36+ Clear wavy boundary
2.5Y N3/ (very dark grey) and 2.5Y N2/ (black) wet weathering shale.

Profile F3R (contd.)

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III %	Ca	Mg	K	Na	CEC
	0-1	4.0	3.1	0.40	360	270	3400	6050	11.7	0.8	1.9	0.4	0.1	19.5
	2-5	4.1	1.4	0.23	280	440	3390	6460	13.3	0.3	0.7	0.2	0.1	11.3
	7-10	4.6	0.5	0.12	180	210	2750	4370	10.0	0.3	0.5	0.1	0.1	9.8
	14-17	4.8	0.2	0.09	130	220	2180	5010	10.9	0.2	0.8	0.1	0.1	11.9
	20-25	4.7	0.5	0.12	180	330	2050	3800	8.8	1.6	2.0	0.1	0.1	19.5
	20-25	4.9	0.2	0.06	110	410	1510	2910	6.3	1.0	1.8	0.5	0.1	4.4
	26-29	5.0	0.3	0.05	140	650	1680	2640	4.6	1.9	1.5	Tr	Tr	4.7
	30-33	3.6	1.9	0.09	90	1150	2190	2970	3.7	3.6	1.7	0.1	Tr	12.6

Sample	% of fine earth					Texture
	Coarse sand	Medium sand	Fine sand	Silt	Clay	
	1	2.9	2.4	8.5	42.9	
2	0.4	1.0	13.8	35.2	41.6	Clay
3	0.4	1.7	24.2	37.0	35.9	Clay loam
4	0.3	1.0	19.8	34.4	41.4	Clay
5	3.3	5.8	29.5	32.1	30.2	Clay loam
6	12.0	12.2	30.6	14.1	19.8	Sandy clay loam
7	15.0	22.1	30.5	15.4	15.6	Sandy loam
8	1.8	11.9	37.3	21.8	22.1	Sandy clay loam

Profile F3S

Sarawak classification: Red Yellow Podsollic
 Location: Plot 6, Sample O24, Unit 1. South of Batang Rajang (see Map 2).
 Topography: Upper slope in low undulating terrain (gradient ca 30°).
 Parent material: Belaga formation (Pelagus member) sandstone and shale.
 Vegetation: Secondary forest.

- | | | | |
|--|--------|--------|-------|
| | G.S.G. | Family | Phase |
| | Merit | Deep | |
- 1/4-0 Dark reddish brown litter and roots.
- 0-2 10YR 5/6 (yellowish brown) with few fine faint 10YR 7/4 (very pale brown) mottles, clay, very weak crumb to subangular blocky, moist, friable, slightly porous, roots abundant.
- Gradual regular boundary
- 2-7 10YR 6/8 (brownish yellow) with few fine faint 10YR 7/1 (light grey) mottles, clay, weak medium subangular blocky, with moderate continuous clayskins [10YR 5/6 (yellowish brown)], moist, slightly firm, slightly porous, many roots, few soft patches of red and yellow weathering sandstone.
- Gradual wavy boundary
- 7-14 As above but clayskins are 10YR 7/4 (very pale brown), moist, firm, few roots, many patches of slightly hard weathering red and grey sandstone, common pieces of hard grey, red and brown mudstone, scattered fine white quartz grit.
- Gradual wavy boundary
- 14-25 10YR 6/6 (yellowish brown) with very few fine faint 2.5Y 7/2 (light grey) mottles, clay, weak medium subangular blocky with strong continuous clayskins [2.5Y 7/4 (pale yellow) and 10Y 7/6 (yellow)] moist, firm, slightly porous, roots rare.
- Gradual wavy boundary
- 25-35 As above plus abundant pieces of slightly hard grey, olive brown and red mudstone, plus few patches of soft red and yellow weathering sandstone.
- Gradual wavy boundary
- 35-54 Dark grey, hard mudstone with patches of orange red, brownish blue, and brown colours along laminations.

Sample no.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable mc./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III%	Ca	Mg	K	Na	CEC
1	0-2	3.8	2.6	0.31	290	210	2240	3860	9.4	0.2	0.5	0.3	Tr	16.7
2	3-6	3.9	1.0	0.17	200	360	2396	5610	11.8	0.2	Tr	0.1	Tr	13.2
3	9-12	4.4	0.5	0.13	160	Tr	2070	4690	12.5	0.2	Tr	0.1	Tr	4.2
4	18-21	4.5	0.5	0.14	160	210	2370	5650	12.8	0.1	Tr	0.1	Tr	11.8
5	28-32	4.9	0.5	0.11	140	310	3070	4830	11.9	0.1	Tr	0.1	Tr	10.0
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample 1					3.0	2.1	20.2	37.4	35.6	Clay loam				
2					3.0	1.0	20.0	33.1	42.5	Clay				
3					5.3	1.4	21.6	29.4	42.1	Clay				
4					3.5	0.6	18.8	32.7	41.5	Clay				
5					10.1	1.7	19.1	30.5	30.0	Stony clay loam				

Profile F3T

Sarawak classification: G.S.G. Family Merit Phase Shallow
 Red Yellow Podsollic
 Location: Plot 1, Sample O24, Unit 1. South of Batang Rajang (see Map 2).
 Topography: Crest of minor ridge (gradient ca 30°).
 Parent material: Belaga formation (Pelagus member) shale.
 Vegetation: Secondary forest.

¼-0 Dark brown root litter.

0-4 10YR 6/4 (light yellowish brown), clay loam, common medium sub-angular blocky breaking to moderate fine crumb, moist, firm, slightly porous, many roots, scattered charcoal.

Gradual regular boundary

4-12 7.5YR 6/8 (reddish yellow), clay loam to clay, moderate medium to coarse subangular blocky with strong continuous clayskins [10YR 6/4 (light yellowish brown)], moist, firm, non porous, common roots, few old medium root channels filled with 10YR 6/4 (yellowish brown) sandy clay loam to clay loam, common coarse charcoal.

Gradual regular boundary

12-20 7.5YR 6/6 (reddish yellow), clay to clay loam, moderate medium sub-angular blocky with strong continuous clayskins [10YR 6/8 (reddish yellow)], moist, firm, slightly porous, few roots, many pieces of hard iron coated red shale and mudstone.

Gradual wavy boundary

20-26 As above, stones abundant.

Gradual regular boundary

26-35 7.5YR 6/6 (reddish yellow), gritty clay, structure dominated by stones with strong continuous clayskins [7.5YR 6/6, 6/8 (reddish yellow)], very moist, firm, few roots, abundant soft and slightly hard grit and stones of yellow and red weathering shale and mudstone.

Clear wavy boundary

35-48+ In situ weathering rock shale and mudstone, mostly 2.5Y 7/1 (very light grey) but many alteration colours to pale yellow, yellow, reddish yellow, orange, light red; with few thin layers of reddish yellow clay between bedding planes, roots absent.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III%	Ca	Mg	K	Na	CEC
1	0-4	3.4	2.1	0.25	200	220	2240	3930	12.7	0.1	Tr	0.1	Tr	17.6
2	6-10	3.9	0.7	0.11	170	110	2710	3709	13.6	0.1	Tr	0.1	Tr	15.8
3	15-18	4.4	1.6	0.10	140	320	1480	5010	17.1	Tr	Tr	0.1	Tr	12.0
4	22-25	4.5	0.2	0.10	160	210	2140	6870	17.9	0.2	Tr	0.1	Tr	13.5
5	29-32	4.6	0.3	0.11	140	110	2900	6240	13.2	0.1	Tr	0.1	Tr	12.3
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample 1					1.7	0.7	14.6	37.4	34.0	Clay loam				
2					1.2	0.6	20.4	31.5	44.5	Clay				
3					10.4	1.9	18.1	25.7	42.7	Clay				
4					4.8	1.3	15.5	28.5	42.0	Clay				
5					3.7	3.0	19.0	37.1	35.3	Stony clay				

Profile F3U X

Sarawak classification:

G.S.G.

Family

Recent Alluvial

Seduau

Location: Plot 4, Sample O24, Unit I. Close to Btg. Rajang,
downstream of Punan Ba.

Topography: Levee of minor stream (gradient 0-1°).

Parent material: Recent alluvium derived from Belaga Formation.

Vegetation: Secondary forest.

½-0 Dark reddish brown. Litter roots and dead leaves.

0-3 10YR 4/3 (dark brown) with few fine faint 10YR 7/1 (light grey) mottles, clay to silty clay, crumb, moist, friable, roots abundant.

Gradual regular boundary

3-9 7.5YR 6/8 (reddish yellow) with many medium distinct 2.5Y 7/4 (pale yellow) mottles, clay, weak medium subangular blocky with weak continuous clayskins [10YR 7/6 (yellow)], moist, firm, slightly porous, many roots.

Gradual wavy boundary

9-17 Mixed distinct 2.5YR 6/8 (light red) and 2.5Y 7/4 (pale yellow) with few fine faint 2.5Y N7/ (light grey) mottles, clay, moderate medium subangular blocky with weak continuous clayskins [10YR 7/6 (yellow)], moist, firm, very slightly porous, roots very rare.

Diffuse boundary

17-44 2.5YR 6/8 (light red) with many medium distinct 5Y 7/4 (pale yellow) and few fine faint 2.5Y N7/ (light grey) mottles, clay, moderate medium subangular blocky with weak continuous clayskins [10YR 7/6 (yellow)], moist, firm, slightly porous, roots absent.

Gradual diffuse boundary

44-50 2.5Y 6/4 (olive yellow) with many medium distinct 2.5YR 4/8 (red) and 2.5Y N7/ (light grey) mottles, clay, weak medium subangular blocky, moist, slightly firm, non-porous, roots absent, common pieces of hard 10YR 3/2 (very dark greyish brown), 7.5YR 5/6 (strong brown) and 2.5YR 6/8 (light red) mudstone, scattered quartz grit.

Gradual wavy boundary

50-55+ 7.5YR N6/ (grey) with many medium distinct 5Y 6/2 (light grey) and 7.5YR 6/8 (reddish yellow) mottles, clay loam, massive, very wet, sticky, plastic, many pieces of hard 7.5YR 3/2 (dark brown) and 5YR 2/2 (dark reddish brown) mudstone.

Profile F3U (contd.)

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III %	Ca	Mg	K	Na	CEC
1	0-3	3.2	2.7	0.36	370	110	2210	4650	9.8	1.6	1.8	0.3	0.1	17.1
2	4-6	3.7	0.7	0.15	190	110	2900	3780	8.7	1.1	1.8	0.1	Tr	13.2
3	11-14	4.8	0.2	0.06	120	210	2630	4960	9.7	0.3	0.7	Tr	Tr	22.8
4	22-25	4.3	0.2	0.09	130	210	2510	4280	9.6	0.2	0.8	0.1	Tr	10.8
5	30-35	4.9	0.1	0.07	120	110	2450	4290	9.0	0.4	0.1	0.1	Tr	10.3
6	46-49	4.6	0.2	0.01	120	210	2250	4690	9.2	0.9	1.9	0.1	Tr	9.6
7	51-55	4.6	0.2	0.09	160	210	2880	4490	9.6	2.0	1.7	0.1	0.1	11.3

Sample	% of fine earth					Texture
	Coarse sand	Medium sand	Fine sand	Silt	Clay	
1	1.5	1.1	19.1	38.6	42.9	Clay
2	0.1	0.7	24.8	37.5	39.4	Clay loam
3	0.1	0.3	26.8	31.3	40.4	Clay
4	0.1	0.5	26.4	34.5	40.1	Clay
5	0.2	0.6	31.8	34.2	38.4	Clay loam
6	1.6	2.5	34.1	33.6	28.9	Clay loam
7	6.2	5.4	21.3	37.0	26.8	Clay loam

Profile F3V

Sarawak classification: G.S.G. Family Skeletal Phase Light
 Location: Plot 7, Sample O94, Unit I. Ulu Dangan, Belaga (see Map 2).
 Topography: Crest of minor spur (gradient 15-20°).
 Parent material: Belaga Formation (Pelagus member) sandstone.
 Vegetation: Mixed Dipterocarp Forest.

0-1 A1 Mixed 10YR 5/8 (yellowish brown) and 10YR 4/4 (dark yellowish brown), medium sandy loam, very weak very fine angular blocky, moist, slightly friable, non-porous, abundant roots, many angular pieces of slightly hard 2.5YR 6/6 (light red) orange, medium sandstone.

1-28 B Gradual regular boundary
 7.5YR 6/8 (reddish yellow) with few fine faint 2.5Y 7/4 (pale yellow) mottles, stony medium sandy loam to loamy sand, very weak fine subangular blocky, moist, soft, non-porous, many roots, abundant large pieces of soft to hard 5Y 7/1 (light grey), 5YR 7/3 (pink) 7.5YR 5/6 (strong brown), 7.5YR 5/6 (red), and 7.5YR 7/8 (reddish yellow) medium sandstone.

28-50 Gradual diffuse boundary
 7.5YR 6/8 (reddish yellow), rocky loamy sand, very weak fine subangular blocky, moist, soft; non-porous, many roots, abundant stones - as above but harder.

50-54+ Gradual wavy boundary
 As above but soil only as few thin lenses between rocks.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III%	Ca	Mg	K	Na	CEC
1	0-1	3.4	1.5	0.19	150	100	560	1540	4.9	Tr	0.1	0.2	0.1	10.7
2	19-22	4.4	0.2	0.03	70	200	520	2330	5.4	Tr	Tr	0.1	Tr	4.7
3	35-38	4.8	0.1	0.03	60	100	460	2540	6.5	Tr	Tr	0.1	0.1	35.0
4	50-54	5.8	0.1	0.01	60	40	710	2690	6.7	Tr	Tr	0.1	0.2	3.6
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample 1					2.9	5.6	59.0	15.9	13.4	Sandy loam				
2					4.1	12.3	61.7	12.1	11.5	Stony sandy loam				
3					2.4	18.5	59.9	12.5	8.0	Stony loamy sand				
4					23.1	21.6	42.0	9.3	4.6	Stony loamy sand				

					Coarse sand	Medium sand	Fine sand	Silt	Clay	Texture				
Sample 1					0.6	1.5	57.7	18.5	19.2	Sandy clay loam				
2					0.3	1.1	58.0	20.4	23.1	Sandy clay loam				
3					0.9	1.4	57.5	15.3	23.9	Sandy clay loam				
4					2.5	2.4	59.3	17.4	19.4	Sandy sandy loam				
5					5.6	2.9	56.9	20.4	9.2	Sandy sandy loam				

Profile F3Y

Sarawak classification: G.S.G. Family Phase
 Skeletal Kapit Light
 Location: Plot 3, Sample 094, Unit I. Ulu Dangan, Belaga (see Map 2).
 Topography: Midslope of minor spur (gradient ca 25°).
 Parent material: Belaga Formation (Pelagus member) sandstone.
 Vegetation: Mixed Dipterocarp Forest.

0-2 10YR 5/8 (yellowish brown) with many medium to coarse distinct 2.5Y N5/ (light grey), 2.5Y 6/4 (light yellowish brown), 7.5YR 5/6 (strong brown) and 7.5YR 7/8 (reddish yellow) mottles, medium sandy loam to medium sandy clay loam, weak fine subangular blocky, moist, friable, slightly porous, abundant roots, many pieces of hard to soft yellow and red medium sandstone.

Gradual regular boundary

2-9 10YR 6/8 (brownish yellow), stony medium sandy loam to sandy clay loam, structure dominated by stones, but weak fine subangular blocky in small patches, moist, friable, slightly porous, common roots, abundant pieces of hard to soft 10R 6/6 (red), 2.5YR 4/6 (red), 5Y 7/2 (light grey) and yellow medium sandstone.

Diffuse boundary

9-24 10YR 7/8 (yellow), stony sandy clay loam, structure dominated by stones, but patches of weak medium subangular blocky with weak discontinuous clayskins against stone surfaces, moist, slightly firm, slightly porous, common roots, abundant large pieces of hard sandstone, colours as above with 5Y 7/2 (light grey) and 2.5Y 4/6 (red) predominant.

Diffuse boundary

24-48+ As above but stones increase to be main constituent. Soil only in few small patches between stones, structure completely dominated by stones, roots rare.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III%	Ca	Mg	K	Na	CEC
1	0-2	3.9	0.8	0.11	110	40	740	2260	5.2	Tr	Tr	0.2	0.1	5.9
2	4-8	4.5	0.3	0.06	120	100	950	3240	6.8	Tr	Tr	0.1	Tr	6.0
3	15-18	5.0	0.1	0.04	80	80	1150	3890	7.3	Tr	Tr	Tr	Tr	13.3
4	31-35	5.2	0.1	0.04	90	100	1050	3350	6.5	Tr	Tr	0.1	Tr	6.6
5	45-48	5.2	0.1	0.04	90	40	1180	3760	6.4	Tr	Tr	0.1	Tr	6.8
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample 1					1.7	6.4	66.3	12.5	13.7	Sandy loam				
2					4.8	8.2	60.2	15.7	13.3	Sandy loam				
3					3.8	6.4	61.5	14.8	14.4	Stony sandy loam				
4					14.3	7.1	50.3	12.8	12.6	Stony sandy loam				
5					8.2	14.3	48.5	16.1	14.5	Stony sandy loam				

Profile F3Z

Sarawak classification: G.S.G. Family Phase
Red Yellow Podsollic Merit Deep

Location: Plot 9, Sample 034, Unit I. Ulu Merit (see Map 2)

Topography: Gullied midslope of minor ridge (gradient ca 15°).

Parent material: Belaga Formation (Metah member) shale, sandstone and conglomerate.

Vegetation: Mixed Dipterocarp Forest.

- ¼-0 Dark reddish brown. Litter and roots and dead leaves.
- 0-2 10YR 5/4 (yellowish brown) with fine few faint 2.5Y 7/4 (pale yellow), and 5Y 7/1 (light grey) mottles, clay loam to clay, very weak fine subangular blocky, moist, friable, porous, roots abundant.
A1
- 2-5 10YR 7/8 (yellow) with many medium distinct 7.5YR 7/8 (reddish yellow), 5Y 7/1 (light grey) and 2.5Y 6/2 (light brownish grey) mottles, clay, weak coarse subangular blocky breaking to moderate fine granular, moist, firm, slightly porous, many roots.
A2
Clear regular boundary
- 5-11 7.5YR 7/8 (reddish yellow) with few fine faint 2.5Y 7/4 (pale yellow) mottles, clay, moderate medium subangular blocky with weak continuous clayskins [10YR 7/6 (yellow)], moist, firm, slightly porous, many roots, scattered white rounded quartz stones.
Gradual wavy boundary
- 11-18 7.5YR 6/6 (reddish yellow) with few fine faint 5Y 8/4 (pale yellow) mottles, clay, moderate medium subangular blocky with strong continuous clayskins [10YR 7/6 (yellow)], moist, firm, slightly porous, few roots, few hard white subrounded quartz, few soft pieces of 2.5YR 4/4 (reddish brown) sandstone.
Gradual wavy boundary
- 18-30 5YR 7/8 (reddish yellow) with many medium distinct 5Y 8/4 (pale yellow) mottles, clay, moderate medium subangular blocky with strong continuous clayskins [7.5YR 6/6 (reddish yellow)], moist, firm, slightly porous, roots rare, many pieces of very hard 2.5YR 4/6 (red) and 7.5YR 5/6 (strong brown) shale, few hard white subrounded quartz stones.
B
Clear to gradual wavy boundary
- 30-43 5YR 7/8 (reddish yellow) with many medium distinct 2.5Y 7/4 (pale yellow) mottles, clay to gritty clay, weak medium subangular blocky with strong discontinuous clayskins [7.5YR 6/6 (reddish yellow)], moist, firm; slightly sticky, non-porous, roots absent, abundant pieces of soft to slightly hard 2.5YR 4/8 (red) purple, 7.5YR 5/6 (strong brown) fine sandstone, stoneline of hard white angular to subrounded quartz at 35-39".
- 43-53+ Purple, soft weathering fine sandstone 5Y 8/4 (pale yellow) and 7.5R 3/6 (dark red) with small pockets of reddish yellow clay.

Profile F3Z(contd.)

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III%	Ca	Mg	K	Na	CEC
1	0-2	4.3	5.0	0.39	100	110	1190	3710	6.1	0.2	0.2	0.4	0.1	21.8
2	2-5	4.8	0.8	0.10	50	170	1390	4330	8.0	0.6	Tr	0.1	Tr	9.1
3	6-9	4.9	0.3	0.06	40	40	1430	5190	9.4	Tr	Tr	0.1	Tr	9.1
4	12-16	4.8	0.3	0.05	40	100	1640	5410	10.5	Tr	Tr	0.1	Tr	7.8
5	23-26	5.8	0.2	0.05	40	40	1940	6040	13.0	Tr	Tr	0.2	0.3	7.8
6	35-38	5.6	0.2	0.04	50	100	1860	6980	13.6	Tr	Tr	0.1	0.1	7.0
7	45-53	5.3	0.1	0.02	50	190	1160	4760	12.1	Tr	Tr	0.1	Tr	4.3
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample	1	1.6	1.3	31.0	27.8	33.8	Clay loam							
	2	1.6	1.4	38.0	27.4	31.5	Clay loam							
	3	2.3	1.2	36.9	21.4	36.4	Clay loam							
	4	1.7	1.2	35.5	25.9	37.0	Clay loam							
	5	6.0	1.5	29.2	19.3	39.2	Clay - clay loam							
	6	17.8	2.7	24.6	23.1	32.7	Clay loam							
	7	4.8	2.3	58.2	21.9	13.2	Sandy loam							

Profile F3AA

Sarawak classification: G.S.G. Family Phase
Red Yellow Podsollic Merit Deep
Location: Plot 6, Sample 034, Unit I. Ulu Merit (see Map 2).
Topography: Saddle on crest of major ridge (gradient ca 5°).
Parent material: Belaga Formation (Metah member) shale
Vegetation: Mixed Dipterocarp Forest.

- ¼-0 Dark reddish brown to dark brown litter with very few whole leaves.
- 0-½ 10YR 3/3 (dark brown), clay loam, moderate fine crumb, moist, friable, porous, roots abundant.
- ½-3
A1 Clear regular boundary
10YR 7/4 (very pale brown) with few medium distinct 2.5Y N7/ (light grey) and common medium distinct 10YR 4/3 (brown to dark brown) mottles, clay loam, moderate medium to fine subangular blocky, moist, slightly hard, porous, roots abundant.
- 3-14
A2 Clear regular boundary
7.5YR 8/6 (reddish yellow) with many fine very faint 10YR 8/6 (yellow) mottles, clay loam to clay, moderate medium subangular blocky with moderate discontinuous clayskins [10YR 7/6 (yellow)], moist, slightly hard, porous, many roots.
- 14-29
B Gradual regular boundary
5YR 7/8 (reddish yellow) with common medium distinct 10YR 8/6 (yellow) mottles, clay, very weak medium subangular blocky, tending to massive, with strong continuous clayskins [7.5YR 7/6 (reddish yellow)], very moist, slightly sticky, very plastic, very slightly porous, common roots, few old root channels with dark yellow sandy clay loam, scattered angular quartz grit.
- 29-36 Clear wavy boundary
5YR 7/8 (reddish yellow) with many medium to fine distinct 10YR 8/6 (yellow), 2.5Y 8/4 (pale yellow) and common fine distinct 2.5Y 7/2 (light grey) mottles, clay, very weak medium subangular blocky, tending to massive, with weak discontinuous clayskins against stones, very moist, slightly sticky, plastic, non-porous, few roots, many small hard fragments of, black, dark brown shale, much white angular quartz grit, few hard fragments of yellow coarse sandstone.
- 36-54+ Gradual wavy boundary
Mixed 2.5YR 6/6 (light red), 2.5Y 8/6 (pale yellow) and 10YR 8/1 (white), clay, massive, very moist, sticky, very plastic, non-porous, roots abundant, few hard medium fragments of dark brown and dark reddish brown shale.

Soil Profile F3AA (contd.)
 Location: ...
 Topography: ...
 Parent Material: ...
 Profile Description: ...

Profile F3AA(contd.)

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III%	Ca	Mg	K	Na	CEC
1	1/2-3	4.4	2.7	0.22	80	40	1470	4060	7.4	0.3	0.2	0.3	0.1	15.1
2	7-10	4.6	0.4	0.06	50	110	1380	6180	10.0	0.2	0.1	0.1	0.1	11.5
3	19-23	4.6	0.3	0.06	50	40	2270	5290	11.9	0.1	0.1	0.1	0.1	11.0
4	31-35	4.8	0.2	0.04	50	40	2190	5830	14.4	0.1	0.1	0.1	0.1	9.7
5	50-54	5.0	0.1	0.06	40	90	710	1960	12.9	0.3	0.1	0.1	0.1	9.2

Sample	% of fine earth					Texture
	Coarse sand	Medium sand	Fine sand	Silt	Clay	
1	3.7	3.2	30.7	33.9	28.1	Clay loam
2	0.5	0.9	33.3	27.7	37.9	Clay loam
3	0.5	0.7	32.7	27.8	42.9	Clay - clay loam
4	4.4	0.8	28.7	27.6	41.4	Clay - clay loam
5	0.9	0.4	32.4	30.2	37.0	Clay loam

10B 7/2 (yellow) with fine line distinct 7.5B 8/7 (light grey) matrix, medium sandy clay, with medium subangular blocky, moist, slightly firm, very porous, roots rare, abundant pieces of soft 10B 6/1 (grey), 5B 7/1 (light grey) and yellow medium sandstone.

Clear regular boundary
 10B 5/6 (yellowish brown) with many medium distinct 7.5B 8/7 (light grey) and 7.5B 6/6 (reddish yellow) nodules, clay, with fine subangular blocky with strong continuous clayeyness, 10B 6/3 (reddish brown), moist, slight firm, very porous, roots abundant, many pieces of soft 10B 5/1 (very dark grey) and 7.5B 5/6 (strong brown) sandstone.

Clear irregular boundary
 10B 5/6 (yellowish brown) with many medium distinct 7.5B 8/7 (light grey) and 7.5B 6/6 (reddish yellow) nodules, clay, with fine subangular blocky with strong continuous clayeyness, 10B 6/3 (reddish brown), moist, slight firm, very porous, roots abundant, many pieces of soft 10B 5/1 (very dark grey) and 7.5B 5/6 (strong brown) sandstone.

Gradual wavy boundary
 10B 5/6 (yellowish brown) with fine line distinct 7.5B 8/7 (light grey) matrix, clay, with medium subangular blocky, moist, firm, non-porous, roots absent, many pieces of soft 7.5B 8/7 (grey), orange, 2.5B 5/4 (light olive yellow) and 2.5B 5/6 (red) sandstone and very fine sandstone. Few pieces of strong brown dipstick.

Profile F3AB

Sarawak classification. G.S.G. Family Phase
Red Yellow Podsollic Bekenu Shallow
Location: Plot 2, Sample 004, Unit I. Ng Stapang, Ulu Pila (see Map 2).
Topography: Lower slope of minor spur (gradient ca 25°).
Parent material: Belaga Formation (? Pelagus or Metah member), sandstone
and shale.
Vegetation: Old secondary forest.

¼-0 Dark greyish brown litter roots and dead leaves.

0-2 10YR 4/2 (dark greyish brown) with many medium distinct 7.5YR 7/8 (reddish yellow) and few fine faint 2.5Y N7/ (light grey) mottles, medium sandy clay, very weak fine subangular blocky, wet, soft, slightly porous, roots abundant.

A1

Gradual wavy boundary

2-5 7.5YR 6/6 (yellow) with many fine distinct 7.5YR N6/(grey), 5YR 4/4 (reddish brown), 10YR 5/2 (greyish brown) and few fine faint 5YR 5/8 (yellowish red) mottles, medium sandy clay, weak medium subangular blocky, moist, slightly firm, slightly porous, many roots, rare charcoal.

Gradual wavy boundary

5-16 10YR 7/6 (yellow) with many fine distinct 5Y 7/2 (light grey) and few fine faint 2.5Y 7/4 (pale yellow) and 7.5YR 7/8 (reddish yellow) mottles, medium sandy clay loam to medium sandy clay, weak medium subangular blocky with weak discontinuous clayskins \angle 10YR 6/6 (brownish yellow) \angle , moist, firm, slightly porous, many roots, few pieces of soft 7.5YR 5/6 (strong brown) medium sandstone. Common old root channels filled with dark greyish brown sandy clay loam.

A2

Diffuse boundary

16-27 7.5YR 7/8 (reddish yellow) with few fine distinct 5Y 7/2 (light grey) and few fine faint 5Y 7/3 (pale yellow) mottles, medium sandy clay loam to medium sandy clay, weak moderate subangular blocky, moist, firm, very porous, few roots, many pieces of soft orange and 7.5YR 5/6 (strong brown) medium sandstone, much charcoal.

B

Gradual wavy boundary

27-36 10YR 7/8 (yellow) with few fine distinct 7.5YR N7/ (light grey) mottles, medium sandy clay, weak medium subangular blocky, moist, slightly firm, very porous, roots rare, abundant pieces of slightly hard to soft 5Y 6/1 (grey), 5Y 7/1 (light grey) and yellow medium sandstone.

Clear regular boundary

36-42 Stone line of hard 2.5Y 6/6 (olive yellow), 2.5Y 5/4 (light olive yellow), 5Y 6/1 (grey), 2.5YR 6/8 (light red), 7.5YR 5/6 (strong brown) and orange angular to subangular sandstone. Interstitial material is 10YR 6/6 (brownish yellow) medium sandy clay.

Clear irregular boundary

42-54 10YR 5/6 (yellowish brown) with many medium distinct 7.5YR N7/ (light grey) and 7.5YR 6/6 (reddish yellow) mottles, clay, weak fine subangular blocky with strong continuous clayskins \angle 10YR 6/3 (reddish brown) \angle , moist, slight firm, very porous, roots abundant, many pieces of soft 10YR 3/1 (very dark grey) and 7.5YR 5/6 (strong brown) sandstone.

Gradual wavy boundary

54-59+ 10YR 5/6 (yellowish brown) with few fine distinct 7.5YR N7/. (light grey) mottles, clay, weak medium subangular blocky, moist, firm, non-porous, roots absent, many pieces of soft 7.5YR N5/. (grey), orange, 2.5Y 5/4 (light olive yellow) and 2.5YR 5/6 (red) mudstone and very fine sandstone. Few pieces of strong brown pipestone.

Profile F3AB (contd.)

Sample	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III%	Ca	Mg	K	Na	CEC
1	0-2	5.0	2.4	0.20	190	220	750	2630	3.3	0.9	0.3	0.5	0.6	10.4
2	2-5	3.9	1.3	0.11	150	100	840	2690	3.9	0.1	0.1	0.2	0.1	7.9
3	8-11	4.1	0.5	0.07	150	170	1150	3630	5.6	0.1	0.1	0.1	0.1	8.3
4	20-22	4.4	0.4	0.04	140	100	930	3550	5.8	0.1	Tr	0.1	0.1	6.0
5	30-32	4.7	0.2	0.04	170	40	1080	4440	6.2	0.2	Tr	0.1	0.1	5.3
6	37-40	5.5	0.1	Tr	150	200	490	3190	5.6	0.3	Tr	0.1	0.1	3.3
7	46-48	4.7	0.4	0.06	220	100	1050	5370	7.7	0.2	Tr	0.1	0.1	5.3
8	54-59	4.9	0.4	0.06	210	100	1110	7110	9.5	0.1	0.3	0.1	0.1	10.1

Sample	% of fine earth					Texture
	Coarse sand	Medium sand	Fine sand	Silt	Clay	
1	1.0	9.4	52.5	15.1	18.6	Sandy clay loam - sandy loam
2	0.9	9.3	57.3	17.1	18.3	Sandy loam
3	1.5	9.3	52.6	16.8	21.5	Sandy clay loam - sandy loam
4	4.5	11.8	51.6	13.4	19.1	Sandy loam
5	9.6	11.8	43.1	19.1	18.9	Sandy loam
6	17.3	23.4	42.6	7.4	9.4	Loamy sand
7	2.8	3.4	37.7	26.9	31.6	Clay loam
8	6.7	4.9	30.1	30.3	29.8	Clay loam

Soil description notes:

0-2/2: Dark brown to black, silty loam, very dark red, strong, hard, sticky, brown, shiny.

2-5/2: Dark brown to black, silty loam, very dark red, strong, hard, sticky, brown, shiny.

8-11/2: Dark brown to black, silty loam, very dark red, strong, hard, sticky, brown, shiny.

20-22/2: Dark brown to black, silty loam, very dark red, strong, hard, sticky, brown, shiny.

30-32/2: Dark brown to black, silty loam, very dark red, strong, hard, sticky, brown, shiny.

37-40/2: Dark brown to black, silty loam, very dark red, strong, hard, sticky, brown, shiny.

46-48/2: Dark brown to black, silty loam, very dark red, strong, hard, sticky, brown, shiny.

54-59/2: Dark brown to black, silty loam, very dark red, strong, hard, sticky, brown, shiny.

Other irregular boundary

Matrix: low red, weak red, golden brown, orange and yellow, especially hard weathering shale.

Other: red and light grey, slightly hard weathering shale with brownish yellow, yellow and reddish yellow brown streaks.

Profile F3AC (contd.)

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III%	Ca	Mg	K	Na	CEC
1	0-2	4.5	2.8	0.19	210	110	1010	3040	4.2	0.5	0.3	0.4	0.1	11.3
2	4-8	4.4	0.6	0.07	140	100	930	3040	4.3	0.3	0.1	0.1	0.1	7.5
3	11-14	4.6	0.3	0.05	180	100	990	4530	6.1	0.2	Tr	0.1	0.1	9.2
4	19-23	4.6	0.3	0.05	240	100	1330	5890	8.5	0.2	Tr	0.1	0.1	10.7
5	31-34	4.5	0.3	0.05	210	110	1470	7880	10.8	0.5	Tr	0.1	0.1	12.0
6	42-45	4.7	0.2	0.05	250	320	1390	7870	11.7	0.3	0.6	0.2	0.1	10.8
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample 1					1.7	10.3	41.2	21.1	23.9	Sandy clay loam				
2					1.8	10.9	48.8	18.4	22.8	Sandy clay loam				
3					1.2	8.0	40.3	21.9	30.3	Sandy clay loam				
4					1.7	4.3	31.6	25.9	38.0	Clay loam				
5					4.0	2.3	21.3	34.0	37.8	Clay loam				
6					5.1	2.9	15.9	45.8	29.6	Weathering shale				

Profile F3AD

Sarawak classification: G.S.G. Family Phase
 Red Yellow Podsollic Nyalau Shallow

Location: Plot 1, Sample 014, Unit I. Ulu Pila (see Map 2).
 Topography: Midslope of major ridge (gradient ca 45°).
 Parent material: Belaga Formation (Pelagus member) sandstone.
 Vegetation: Mixed Dipterocarp Forest.

0-2 A1 10YR 5/4 (yellowish brown), medium sandy loam, very weak fine sub-angular blocky, moist, soft, very porous, abundant roots, few pieces of slightly hard 10YR 7/8 (yellow) and 2.5YR 4/8 (red) medium sandstone.

Diffuse boundary

2-13 A2 10YR 6/8 (brownish yellow), medium sandy loam, very weak fine sub-angular blocky, moist, soft, very porous, many roots, many pieces of hard to slightly hard, 7.5YR 5/8 (strong brown) 2.5Y 7/8 (yellow) and 2.5YR 4/8 (red) medium sandstone.

Diffuse boundary

13-25 B 7.5YR 7/8 (reddish yellow) with few fine faint 10YR 7/6 (yellow) mottles, moderate medium subangular blocky with weak discontinuous clayskins [10YR 6/6 (brownish yellow)], moist, slightly firm, very porous, many roots, many pieces of very hard 5Y 8/4 (pale yellow). 2.5YR 4/8 (red), purple, and 7.5YR 5/6 (strong brown) medium sandstone, common old root channels filled with 10YR 5/2 (greyish brown) sandy loam.

Diffuse boundary

25-47 7.5YR 7/8 (reddish yellow), medium sandy loam to medium sandy clay loam, weak medium subangular blocky, moist, soft, slightly plastic, slightly sticky, slightly porous, many roots, abundant pieces of hard sandstone, colours as above, up to 5-7" in diameter, common roots channels filled with 10YR 5/2 (greyish brown) sandy loam.

Diffuse boundary

47-56+ As above but stones increase in number and size (up to 7-10"). Only small pockets of soil.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III%	Ca	Mg	K	Na	CEC
1	0-2	3.6	1.6	0.17	160	110	630	1850	4.7	0.2	0.2	0.3	0.1	10.9
2	6-8	3.8	0.7	0.09	110	40	1740	6940	6.3	0.1	0.1	Tr	0.1	7.2
3	18-21	4.3	0.4	0.05	100	100	800	2110	7.1	0.1	Tr	Tr	0.1	4.2
4	32-36	4.4	0.3	0.04	100	100	870	2340	6.8	0.3	Tr	Tr	0.1	17.4
5	48-58	4.7	0.3	0.05	110	110	990	2250	7.0	0.2	Tr	0.1	0.1	5.8
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample 1					4.3	12.3	50.1	19.6	12.7	Sandy loam				
2					3.6	12.1	54.1	11.1	16.7	Sandy loam				
3					4.6	13.1	54.4	17.8	12.7	Sandy loam				
4					6.8	13.2	51.9	13.5	15.9	Stony sandy loam				
5					4.5	12.0	50.6	16.2	18.6	Stony sandy loam				

Profile F3AK

Sarawak classification: G.S.G. Family Phase
 Skeletal Kapit Heavy
 Location: Plot 3, Sample 101, Unit 3. Ulu Mengiong (see Map 3).
 Topography: Midslope of minor ridge (gradient ca 50°).
 Parent material: Belaga Formation (? Kapit member) shale.
 Vegetation: Mixed Dipterocarp Forest.

0-5 10YR 6/6 (brownish yellow), clay, very weak fine subangular blocky with continuous clayskins against stones [10YR 7/8 (yellow)], moist, soft, slightly porous, very few roots, abundant subangular pieces of slightly hard to soft, strong brown, red and light yellowish brown shale.

Gradual regular boundary

5-16 10YR 7/8 (yellow), stony clay, weak medium subangular blocky with weak clayskins, continuous against stones [2.5Y 7/6 (yellow)], moist, soft, slightly porous, roots absent, abundant angular - subangular soft to slightly hard pieces of dark olive brown and yellowish red medium sandstone.

Gradual regular boundary

16-25 Hard to very hard light grey and pale olive shale.

25-33 Hard to very hard red and 5Y 6/4 (pale olive) shale.

33-45+ Hard shale. Colours as in 16-25.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III%	Ca	Mg	K	Na	CEC
1	0-5	4.2	1.1	0.16	160	340	930	5680	8.4	0.9	0.1	0.1	Tr	8.6
2	9-12	4.6	0.5	0.11	130	200	1030	6000	9.9	1.4	Tr	0.1	Tr	6.5

Depth (ins.)	pH	% Org. C	% Total N	% of fine earth					Texture
				Coarse sand	Medium sand	Fine sand	Silt	Clay	
Sample 1				11.7	3.4	26.2	31.7	24.2	Loam
Sample 2				18.0	4.0	24.9	23.9	26.6	Stony clay loam

Sample	Depth (ins.)	pH	% Org. C	% Total N	% of fine earth					Texture
					Coarse sand	Medium sand	Fine sand	Silt	Clay	
1					11.1	4.2	14.4	41.0	24.7	Loam
2					1.6	1.4	19.1	46.2	31.4	Clay loam
3					2.3	1.3	14.2	33.6	43.8	Clay
4					5.3	3.1	16.4	35.9	34.7	Clay loam
5					13.1	5.8	16.5	31.7	31.6	Clay loam

Profile F3AL

Sarawak classification: Red Yellow Podsollic
 G.S.G. Family Merit Phase Deep
 Location: Plot 9, Sample 101, Unit 3. Ulu Mengiong (see Map 3).
 Topography: Midslope of intermediate ridge (gradient ca 30°).
 Parent material: Belaga Formation (? Kapit member) shale.
 Vegetation: Mixed Dipterocarp Forest.

1-0 Discontinuous layer of surface roots giving terraced micro-relief.

0-3 10YR 6/4 (light yellowish brown) with many fine faint 7.5YR 6/6 (reddish yellow) mottles, clay loam to clay, moderate fine sub-angular blocky, moist, friable - slightly firm, slightly plastic but not sticky, slightly porous, abundant roots, common pieces of slightly hard pale yellow, orange, light grey and reddish yellow shale.

A1

Gradual regular boundary

3-14 10YR 6/6 (brownish yellow), clay loam to clay, weak medium sub-angular blocky with moderate discontinuous clayskins [10YR 7/6 (yellow)], moist, slightly firm, plastic, very slightly sticky, non-porous, many roots, very few small pieces of soft pale yellow and reddish yellow shale.

A2

Gradual wavy boundary

14-30 10YR 6/6 (brownish yellow) with many fine very faint 7.5YR 6/8 (reddish yellow) mottles, clay, weak coarse subangular blocky with strong continuous clayskins [10YR 6/6 (brownish yellow)] moist to wet, firm, slightly plastic, sticky, non-porous, common roots, few pieces of soft to slightly hard pale yellow, reddish brown and reddish yellow shale.

B

Clear wavy boundary

30-47 Mixture of brownish yellow (10YR 6/6) clay and slightly hard 10R 5/4 (weak red) shale with many fine distinct patches of 5YR 6/6 (reddish yellow) and 5Y 7/3 (pale yellow). In clay patches structure is dominated by stones, but tending to weak medium subangular blocky, moist, slightly firm, plastic, slightly sticky, non-porous, few roots.

Diffuse boundary

47-60+ Hard to slightly hard weathering shale. Colours as stone in 30-47. Few small patches of brownish yellow clay.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P	Ca ppm	Mg ppm	K ppm	Group III%	Ca	Mg	K	Na	CEC
1	0-3	4.7	2.3	0.25	220	350	950	6080	12.4	Tr	Tr	0.2	Tr	14.0
2	7-10	4.2	1.3	0.16	200	330	880	6290	12.5	Tr	1.8	0.1	Tr	9.0
3	20-24	4.8	0.4	0.12	160	350	1100	6940	14.1	Tr	Tr	Tr	Tr	8.3
4	36-40	4.8	0.3	0.09	130	460	1060	10210	17.5	Tr	Tr	Tr	Tr	8.0
5	56-60	5.0	0.2	0.09	120	260	890	5730	12.3	Tr	Tr	Tr	Tr	7.2
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample 1					11.1	4.2	15.6	43.0	24.7	Loam				
2					1.6	1.4	19.1	40.2	35.4	Clay loam				
3					2.3	1.3	14.2	33.6	43.8	Clay				
4					5.3	3.1	16.4	38.9	34.1	Clay loam				
5					13.1	5.6	16.5	31.9	31.6	Clay loam				

Profile F3AM

Sarawak classification: G.S.G. Family Phase
Skeletal Kapit Heavy
Location: Plot 9, Sample 141, Unit 3. Ulu Sepangil, Mengiong
(see Map 3).
Topography: Upper slope of major ridge (gradient ca 20°).
Parent material: Belaga Formation (Kapit member) shale and sandstone.
Vegetation: Mixed Dipterocarp Forest.

- ½-0 10YR 4/3 (dark brown) litter.
- 0-2 10YR 5/6 (yellowish brown) with many fine faint 10YR 6/6 (brownish yellow) mottles, clay, very weak fine subangular blocky, slightly moist, friable, slightly porous, many roots, common white quartz stones, few small pieces of sandstone.
- 2-5 Diffuse boundary
10YR 6/8 (brownish yellow) with few fine faint 5Y 6/2 (light olive grey), 7.5YR 6/8 (reddish yellow) and 5Y 7/4 (pale yellow) mottles, clay, weak medium subangular blocky with moderate continuous clayskins [7.5YR 6/6 (reddish yellow)], moist, slightly firm, slightly porous, many roots, few pieces of soft to slightly hard 10R 4/3 (weak red) medium sandstone, abundant angular quartz stones.
- 5-12 Clear slightly wavy boundary
7.5YR 7/8 (reddish yellow) with few fine faint 5Y 7/3 (pale yellow) mottles, clay, moderate medium subangular blocky with strong continuous clayskins [10YR 7/6 (yellow)], moist, firm, very porous, common roots, many pieces of slightly hard to hard 7.5R 3/4 (dusky red), 5Y 8/3 (pale yellow), 5YR 5/8 (yellowish red) and purple medium sandstone veined with white quartz, many scattered white quartz stones.
- 12-23 Clear slightly wavy boundary
Soil in small pockets between stones. Colour, mottles and texture as in 5-12, weak medium subangular blocky with strong continuous clayskins [10YR 7/6 (yellow)], moist, slightly firm, slightly porous, abundant large pieces of hard 5Y 8/3 (pale yellow), 2.5Y N7/ (light grey), 10R 4/4 (weak red) and 7.5YR 5/8 (strong brown) medium sandstone, veined with white quartz, much scattered quartz grit.
- 23-43 Gradual boundary
7.5YR 7/8 (reddish yellow), clay, moderate medium subangular blocky with strong continuous clayskins [10YR 7/6 (yellow)], moist, firm, plastic, very porous, few roots, many pieces of slightly hard 2.5Y 7/6 (yellow) 7.5R 4/6 (red) 10R 5/4 (weak red) and 2.5Y 7/8 (yellow) medium sandstone.
- 43-57+ Clear slightly wavy boundary
10YR 7/6 (yellow), clay, weak medium subangular blocky, with strong continuous clayskins [10YR 6/6 (brownish yellow)], slightly porous, roots rare, abundant pieces of soft to slightly hard 10R 5/3 (weak red), 2.5YR 4/8 (red), 2.5Y 8/6 (yellow), 7.5YR 4/2 (weak red) and purple shale.

Profile F3AM

Sarawak classification: G.S.B. Family: *Red Yellow Podsol*
 Location: Plot 1, Sample 142, Plot 3, Ulu Sepang, Kapit, Sarawak
 (see Map 51)
 Topography: Shoulder on upper slope of major ridge (gradient of 15%)
 Parent material: Pelaga Formation (siltstone) shale
 Vegetation: Mixed Dipterocarp Forest

Profile F3AM (contd.)

1-0 Thick discontinuous layer of surface roots.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III%	Ca	Mg	K	Na	CEC
1	0-2	4.2	2.7	0.29	250	210	780	5020	8.4	1.5	0.6	0.4	Tr	14.7
2	2-5	3.8	1.4	0.18	210	250	800	5180	9.5	1.4	0.1	0.4	Tr	9.8
3	7-10	4.1	0.6	0.11	160	260	850	5790	11.2	1.1	Tr	0.1	Tr	8.6
4	12-23	4.8	0.3	0.06	130	270	830	5980	11.9	0.9	Tr	Tr	Tr	6.1
5	30-34	5.3	0.2	0.09	150	380	630	13860	16.3	1.3	Tr	Tr	Tr	5.9

Sample No.	% of fine earth					Texture
	Coarse sand	Medium sand	Fine sand	Silt	Clay	
Sample 1	6.2	3.1	18.6	32.0	35.4	Clay loam
2	11.0	3.5	19.9	31.4	33.5	Loam
3	10.3	3.5	17.4	25.0	37.1	Clay loam
4	15.5	3.0	20.0	21.8	37.3	Clay loam
5	17.3	4.8	14.6	23.8	33.1	Clay loam

21-27 Mixed 2.5Y 5/6 (yellow), 10YR 7/2 (light gray) and 7.5YR 4/6 (reddish yellow) with some fine distinct 7.5YR 5/6 (strong brown) siltstone clay to silty clay, moderate medium subangular blocky with strong continuous claystone / 10YR 7/4 (gray pale brown) and 10YR 7/6 (yellow), moist, firm, slightly plastic, slightly sticky, very slightly porous, roots rare, many pieces of slightly hard 7.5YR 6/6 (reddish yellow) and 2.5YR 4/6 (red) shale

27-31 Slightly hard shale. Dominant colour is 7.5YR 7/6 (reddish yellow) but also layers of 5YR 4/6 (yellow red), 10YR 7/6 (yellow) and 2.5Y 4/3 (weak red). Lamination almost horizontal

31-34+ 2.5Y 6/4 (gray to light gray) very soft shale with many silts and patches of 2.5Y 6/4 (light yellowish brown) clay.

Profile F3AN

Sarawak classification: G.S.G. Family Phase
Red Yellow Podsollic Merit Shallow
Location: Plot 1, Sample 141, Unit 3. Ulu Sepanggil, Mengiong
(see Map 3).
Topography: Shoulder on upper slope of major ridge (gradient ca 15°).
Parent material: Belaga Formation (Kapit member) shale.
Vegetation: Mixed Dipterocarp Forest.

- 1-0 Thick discontinuous layer of surface roots.
- 0-2 Mixed faint 7.5YR 5/4 (brown), 7.5YR 5/6 (strong brown) and 10YR 6/4 (light yellowish brown) with few medium distinct 2.5Y 6/2 (light brownish grey) and 7.5YR 6/6 (reddish yellow) mottles, fine sandy clay loam, weak medium crumb, very moist, friable, porous, abundant roots.
- 2-8
Clear wavy boundary
Mixed faint 2.5Y N7/ (light grey) and 2.5Y 8/2 (pale yellow) with many medium to coarse prominent 7.5YR 6/6 (reddish yellow), 7.5YR 7/8 (reddish yellow), 7.5YR 5/6 (strong brown) and 10YR 7/6 (yellow) mottles. These mottles mostly tubular shape and suggest old root channels. Silty clay to clay, very weak medium subangular blocky tending to massive, moist, firm, very slightly porous, few roots.
- 8-21
Diffuse boundary
Mixed 2.5Y 8/6 (yellow) and 7.5YR 7/8 (reddish yellow) with many prominent 2.5Y N7/ (light grey) and 5YR 4/6 (yellowish red) mottles. The light grey especially concentrated in old root channels (i.e. reverse of above horizon). Clay, weak medium subangular blocky, moist, firm, very slightly porous, few roots, common pieces of soft 10R 5/4 (weak red) shale, common pieces of slightly harder reddish yellow, and orange shale.
- 21-27
Gradual regular boundary
Mixed 2.5Y 8/6 (yellow), 10YR 7/2 (light grey) and 7.5YR 8/6 (reddish yellow) with common fine distinct 7.5YR 5/8 (strong brown) mottles; clay to silty clay, moderate medium subangular blocky with strong continuous clayskins [10YR 7/4 (very pale brown) and 10YR 7/6 (yellow)], moist, firm, slightly plastic, slightly sticky, very slightly porous, roots rare, many pieces of slightly hard 7.5YR 6/6 (reddish yellow) and 2.5YR 4/6 (red) shale.
- 27-31
Clear wavy boundary
Slightly hard shale. Dominant colour is 7.5YR 7/6 (reddish yellow) but also layers of 5YR 4/6 (yellow red), 10YR 7/6 (yellow) and 10R 4/3 (weak red). Laminations almost horizontal.
- 31-34+
Clear wavy boundary
2.5Y N6/ (grey to light grey) very soft shale with many films and patches of 2.5Y 6/4 (light yellowish brown) clay.

Profile F3AN

Soil classification: B.S.S. Family: Clayey
Salicid Melanic heavy
 Location: Plot 3, Sample 142, Unit 5 Near Rtg. Station, upstream of
Palat Nonglong Dam Map 3.
 Topography: Middle of major ridge gradient ca 45%.
 Parent material: Bedrock (Layer number) and Profile F3AN (contd.)
 Vegetation: Mixed Dipterocarp Forest.

142 1072 3/3 (dark brown) lit:

Sample	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III%	Ca	Mg	K	Na	CEC
	0-2	5.0	3.4	0.24	150	360	240	2420	6.5	1.2	0.3	0.3	Tr	12.8
	4-7	4.7	0.5	0.10	110	240	490	4990	15.3	1.8	0.1	0.1	Tr	5.7
	13-16	4.9	0.2	0.09	120	450	630	9980	16.8	Tr	Tr	Tr	0.1	5.8
	22-26	4.7	0.2	0.10	130	330	540	5740	14.1	Tr	Tr	0.1	Tr	6.0
	28-31	5.0	0.2	0.08	220	910	350	4510	25.3	Tr	Tr	0.1	0.1	3.3
	36-48	4.7	0.2	0.11	120	90	670	9790	9.5	Tr	Tr	Tr	Tr	6.7

Sample	% of fine earth					Texture
	Coarse sand	Medium sand	Fine sand	Silt	Clay	
1	5.1	4.1	35.7	28.0	19.2	Sandy loam - loam
2	0.8	1.4	20.7	39.0	35.9	Clay loam
3	3.7	2.2	17.2	41.1	34.2	Clay loam
4	3.7	1.8	16.0	41.8	38.1	Clay loam - silty clay loam
5	13.1	5.6	17.2	32.4	29.8	Clay loam
6	7.7	6.8	23.6	40.8	22.1	Weathering shale

Sample	% of fine earth					Texture
	Coarse sand	Medium sand	Fine sand	Silt	Clay	
1	10.2	4.0	17.5	31.8	29.2	Clay loam
2	7.8	2.9	18.8	39.1	30.5	Clay loam
3	14.5	2.7	19.0	25.0	22.5	Weathering shale

Profile F3AP X

Sarawak classification: G.S.G. Family Phase
 Skeletal Meluan Heavy
 Location: Plot 3, Sample 148, Unit 3. Near Btg. Balleh, upstream of
 Pulau Mengiong (see Map 3).
 Topography: Midslope of major ridge (gradient ca 45°).
 Parent material: Belaga Formation (? Layar member) shale.
 Vegetation: Mixed Dipterocarp Forest.

½-0 10YR 3/3 (dark brown) litter.

0-2 10YR 5/4 (yellowish brown), clay to clay loam, very weak fine subangular blocky, moist, friable, slightly porous, abundant roots, abundant pieces of slightly hard 10YR 7/8 (yellow), 2.5YR 4/6 (red), 2.5Y 5/6 (light olive brown) and 10YR 3/2 (very dark greyish brown) shale.

Diffuse boundary

2-10 7.5YR 6/6 (reddish yellow), clay, very weak fine subangular blocky with weak discontinuous clayskins [7.5YR 5/6 (strong brown)], moist, soft, porous, roots abundant, many pieces of hard shale, colours as in above horizon, much white quartz grit.

Gradual boundary

10-36+ Soil in small pockets between stones. 7.5YR 5/6 (strong brown), stony clay, structure dominated by stones, moist to slightly wet, plastic, slightly sticky, porous, many roots. Stones are hard to very hard 2.5Y N3/ (very dark grey), 5Y 6/2 (light olive grey), 5Y 6/6 (olive yellow) and 5YR 5/3 (reddish brown) shale.

Sample No.	Depth (ins.)	pH H 0 2	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III%	Ca	Mg	K	Na	CEC
1	0-2	3.5	4.8	0.47	500	290	880	10700	13.7	Tr	0.3	0.4	0.1	14.3
2	5-8	3.9	2.7	0.31	460	280	1050	11150	11.3	Tr	0.1	0.2	0.1	13.1
3	30-36	5.0	0.7	0.10	350	300	1670	12590	15.3	Tr	0.1	0.1	0.1	5.1
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample 1					10.2	4.0	17.6	31.8	29.2	Clay loam				
2					7.8	2.7	18.8	39.1	30.5	Clay loam				
3					34.5	5.7	15.0	25.0	22.5	Weathering shale				

Diffuse boundary

52-62+ Yellow and dusky red [with 5YR 9/8 (reddish yellow) in softer patches], slightly hard to hard fine sandstone with common patches of interstitial reddish yellow (5YR 6/8), fine sandy clay to clay, few roots.

Profile F3AQ

Sarawak classification: G.S.G. Family Phase
Red Yellow Podsollic Bekenu Deep
Location: Plot 1, Sample 148, Unit 3. Near Btg. Balleh, upstream
of Pulau Mengiong (see Map 3).
Topography: Upper slope of major ridge (gradient 24°).
Parent material: Belaga Formation (? Layar member) sandstone.
Vegetation: Mixed Dipterocarp Forest.

1-0 5YR 3/2 (dark reddish brown) litter.

A1
0-2 Mixed faint 5YR 5/4 (reddish brown) and 7.5YR 3/2 (dark brown),
fine sandy clay loam, weak medium crumb, moist, very friable,
porous, abundant roots.

2-7 Gradual regular boundary
5YR 6/6 (reddish yellow) with common fine very faint 7.5YR 7/8
(reddish yellow) mottles, fine sandy clay loam, weak fine sub-
angular blocky with very weak discontinuous clayskins, moist,
very friable, porous, many roots, common scattered charcoal,
few pieces of slightly hard yellow and reddish yellow fine sand-
stone, few hard white quartz stones.

7-9 Abrupt wavy boundary
Stone line of charcoal of variable thickness of 1-2", not
completely continuous. Pieces up to 1" in size.

A2
9-16 Abrupt wavy boundary
5YR 6/6 (reddish yellow), fine sandy clay, moderate medium sub-
angular blocky with moderate discontinuous clayskins [reddish
yellow], moist to wet, friable to slightly firm, slightly
plastic but not sticky, porous to very porous, common roots,
few scattered specks of charcoal which increase to common at
lower boundary, rare white angular quartz grit.

B
16-39 Gradual wavy boundary
5YR 6/6 (reddish yellow), fine sandy clay to clay, moderate
coarse subangular blocky, breaking to moderate to strong fine
subangular blocky with strong continuous clayskins [reddish
yellow], moist, firm, slightly plastic but not sticky,
slightly porous, common roots, common pieces of fine to medium
slightly hard 10YR 7/8 (yellow) and hard 10R 3/4 (dusky red) fine
sandstone, rare angular white quartz stones.

39-52 Gradual wavy boundary
As above but stones, especially yellow fine sandstone, increase
to abundant. Also increase in hardness to hard (same as dusky
red sandstone). No increase in quartz. Structure of inter-
stitial reddish yellow fine sandy clay to clay dominated by
stones, roots common.

52-62+ Diffuse boundary
Yellow and dusky red [with 5YR 7/8 (reddish yellow) in softer
patches], slightly hard to hard fine sandstone with common
patches of interstitial reddish yellow (5YR 6/6), fine sandy
clay to clay, few roots.

Profile F3AQ

Soil classification: *Soil Yellow Podzolic* Family: *Podzolic* Rank: *Subsoil*
 Location: *Plot 3, Sample 173, East Y. 140, Berakur, Mangrove*
 (see Map 33)
 Topography: *low slope of river bank (gradient of 30°)*
 Parent material: *Adobe, granitic, fine sand, shales and sandstone*
 Vegetation: *Wet mangrove forest*
 H-0 *Dark brown litter.*

Profile F3AQ (contd.)

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III %	Ca	Mg	K	Na	CEC
1	0-2	3.6	4.1	0.39	360	170	690	4100	9.6	Tr	0.2	Tr	0.1	22.2
2	3-6	3.9	0.8	0.09	160	200	840	4140	12.3	Tr	0.1	0.1	Tr	17.6
3	11-14	4.2	0.3	0.04	130	190	970	4930	13.9	1.6	Tr	Tr	0.1	9.0
4	26-29	4.6	Tr	0.03	130	220	650	10200	15.2	1.3	Tr	Tr	Tr	6.9
5	56-60	4.8	0.1	0.03	110	220	790	13140	13.8	Tr	Tr	Tr	Tr	13.8

Fine sandy clay
 3-33
 Sample 1
 2
 3
 4
 5

% of fine earth					Texture
Coarse sand	Medium sand	Fine sand	Silt	Clay	
0.8	2.1	29.1	30.6	28.8	Clay loam
0.8	1.0	36.5	27.9	28.9	Clay loam
1.7	1.0	35.5	33.2	26.0	Loam
3.3	1.5	34.8	32.6	24.4	Loam
3.4	1.6	32.9	36.2	25.4	Loam

As above but values decrease to almost zero disappear.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III %	Ca	Mg	K	Na	CEC
	0-2	3.7	1.0	0.42	560	200	920	5710	12.2	Tr	0.3	0.1	0.1	12.2
	4-7	4.2	1.1	0.17	330	200	1040	5710	12.2	Tr	0.1	Tr	0.1	37
	19-23	5.0	0.3	0.10	330	200	980	5710	12.2	Tr	0.1	Tr	0.1	15
	46-50	5.1	0.3	0.09	240	200	980	5710	12.2	Tr	0.1	Tr	0.1	15.0

% of fine earth					Texture
Coarse sand	Medium sand	Fine sand	Silt	Clay	
1.3	3.9	29.3	32.7	28.8	Clay loam
3.3	1.1	34.3	32.7	28.6	Clay loam
1.7	3.0	31.1	32.7	28.5	Clay loam
1.5	3.6	31.7	32.7	28.5	Clay loam

Profile F3AR

Sarawak classification: G.S.G. Family Phase
 Red Yellow Podsollic Merit Shallow
 Location: Plot 9, Sample 121, Unit 3. Ulu Seransar, Mengiong
 (see Map 3).
 Topography: Lower slope of minor ridge (gradient ca 30°).
 Parent material: Belaga Formation (Layar member) shale and sandstone.
 Vegetation: Mixed Dipterocarp Forest.

½-0 Dark brown litter.

A1 2-0 10YR 5/4 (yellowish brown) with many medium faint 2.5Y 5/2 (greyish brown) mottles, clay loam, weak fine subangular blocky, moist to wet, friable, slightly plastic, slightly porous, roots abundant, common pieces of hard to slightly hard, 10R 6/3 (pale red) and 5YR 7/6 (reddish yellow) shale.

A2 2-9 Clear wavy boundary
 10YR 8/8 (yellow) with common fine faint 2.5Y 8/6 (yellow), 10YR 8/6 (yellow) and 2.5Y 7/4 (pale yellow) mottles, clay loam, weak moderate subangular blocky, moist, firm, slightly plastic but not sticky, non-porous, common roots, many stones as in above horizon, many old roots channels filled with 10YR 4/2 (dark greyish brown) fine sandy clay loam.

B 9-33 Gradual wavy boundary
 10YR 8/8 (yellow) with common fine faint 2.5Y 8/6 (yellow) mottles, fine sandy clay to clay, weak medium subangular blocky with moderate discontinuous clayskins especially against stones [Mixed 10YR 7/6 (yellow) and 10YR 8/8 (yellow)], moist, firm, plastic, non-porous, rare roots, many pieces of hard to slightly hard fissile shale, colours as in above horizon plus 5YR 6/6 (brownish yellow).

33-50+ Diffuse boundary
 As above but stones increase to abundant, roots disappear.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III %	Ca	Mg	K	Na	CEC
1	0-2	4.7	1.0	0.42	560	290	990	5110	12.8	Tr	0.3	0.3	0.1	12.8
2	4-7	4.2	1.1	0.17	330	380	1060	6530	15.2	Tr	0.1	Tr	0.1	15.2
3	19-23	5.0	0.3	0.10	230	360	930	6630	16.5	Tr	0.1	Tr	0.1	16.5
4	46-50	5.1	0.3	0.09	240	280	990	5330	14.4	Tr	0.1	Tr	0.1	14.4
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample 1					8.5	3.9	9.5	37.9	33.6	Clay loam				
2					5.3	4.1	14.5	38.7	37.0	Clay loam				
3					5.7	3.6	14.6	40.9	35.4	Clay loam				
4					8.6	3.6	11.7	35.9	35.6	Clay loam				

Profile 3AS

Sarawak classification: G.S.G. Family Phase
 Skeletal Kapit Heavy
 Location: Plot 4, Sample 120, Unit 3. Ulu Sekentut, Mengiong
 (see Map 3).
 Topography: Upper slope of minor spur (gradient ca 40°).
 Parent material: Belaga Formation (? Kapit member) shale.
 Vegetation: Mixed Dipterocarp Forest.

0-2 10YR 6/6 (brownish yellow), clay to clay loam, weak fine sub-angular blocky with weak continuous clayskins [10YR 7/6 (yellow)], moist, soft, slightly porous, abundant roots, few pieces of hard to slightly hard 2.5Y 8/4 (yellow), 2.5YR 6/6 (light red) and 10R 4/2 (weak red) shale.

Gradual slightly wavy boundary

2-21 7.5YR 6/8 (reddish yellow), clay, weak medium subangular blocky with strong continuous clayskins [10YR 7/6 (yellow)], moist, slightly firm, slightly porous, common roots, many pieces of soft to slightly hard 5Y 7/2 (light grey), 7.5YR 6/2 (pinkish grey), 10R 4/6 (red) 2.5Y 8/6 (yellow) and 7.5R 4/4 (weak red) very fissile shale.

Gradual wavy boundary

21-38 7.5YR 7/8 (reddish yellow), stony clay, weak moderate subangular blocky but structure mostly dominated by stone with strong continuous clayskins [10YR 7/6 (yellow)], moist, slightly firm, very porous, few roots, stones as in above horizon but increased to abundant.

Gradual wavy boundary

38-55+ 10YR 6/6 (brownish yellow), clay, structure as in 21-38 with strong discontinuous clayskins especially against stones [10YR 7/8 (yellow)], moist, firm, non-porous, rare roots, abundant patches of 7.5R 6/6 (light red), 10R 6/1 (reddish grey) 2.5Y 8/4 (pale yellow) and 10R 5/4 (weak red) soft weathering shale.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III %	Ca	Mg	K	Na	CEC
1	0-2	3.5	1.8	0.21	290	350	670	6780	16.3	Tr	0.2	0.1	0.1	16.3
2	10-13	4.7	0.6	0.11	200	350	830	11390	17.9	Tr	Tr	Tr	Tr	17.9
3	27-30	5.3	0.2	0.04	120	190	380	5340	14.0	Tr	Tr	Tr	Tr	14.0
4	48-54	5.3	0.2	0.07	150	370	550	5720	14.8	Tr	Tr	Tr	Tr	14.8
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample 1					7.7	3.0	15.6	37.2	33.7	Clay loam				
2					6.1	3.4	16.1	36.4	33.9	Clay loam				
3					10.9	2.7	30.6	32.1	22.7	Stony loam				
4					13.1	6.8	19.5	30.5	28.7	Weathering shale				

Profile F3AT

Sarawak classification: G.S.G. Family Phase
 Skeletal Kapit Heavy
 Location: Plot 9, Sample 120, Unit 3. Ulu Sekentul, Mengiong
 (see Map 3).
 Topography: Lower slope of major ridge (gradient ca 35°).
 Parent material: Belaga Formation (? Kapit member) shale and sandstone.
 Vegetation: Mixed Dipterocarp Forest.

- 1/2-0 Mixed dark brown, dark yellowish brown, dark reddish brown litter.
- 0-3 Mixed faint 5YR 6/6 (reddish yellow) and 7.5YR 6/8 (reddish yellow), fine sandy clay loam, weak medium crumb to fine sub-angular blocky with weak discontinuous clayskins [reddish yellow] especially against stones, moist, friable, slightly porous, abundant roots, common pieces of hard to slightly hard red, yellow, reddish yellow and reddish brown shale.
- A1
- 3-13 Clear slightly wavy boundary
 7.5YR 7/6 (reddish yellow) fine sandy clay, moderate medium sub-angular blocky, but structure mostly dominated by stones with continuous clayskins especially against stones [7.5YR 6/6 (reddish yellow)], moist, slightly firm, slightly plastic, non sticky, very slightly porous, common roots, many stones - as in above horizon.
- B
- 13-43 Diffuse boundary
 Mixed 7.5YR 7/6 (reddish yellow), fine sandy clay, structure dominated by stones but sometimes moderate coarse subangular blocky with continuous clayskins (same colour as matrix), moist, firm, slightly plastic, non sticky, non-porous, few roots.
- 43-56+ Diffuse boundary
 Soft to slightly hard red, yellow and reddish yellow weathering shale with strong horizontal laminations. Few films of reddish yellow fine sandy clay to clay, with few roots.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III%	Ca	Mg	K	Na	CEC
1	0-3	3.8	2.7	0.31	380	300	550	5110	13.3	Tr	0.2	0.2	0.1	13.3
2	7-10	4.3	0.9	0.16	280	330	730	11580	15.7	Tr	0.1	Tr	Tr	15.7
3	26-30	5.2	0.4	0.10	230	290	740	10980	16.9	Tr	Tr	Tr	Tr	6.4
4	47-51	5.6	0.3	0.10	210	270	690	10600	16.1	Tr	Tr	Tr	Tr	7.2
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample 1					4.2	2.5	14.7	37.3	33.0	Clay loam				
2					4.9	2.7	13.8	41.1	36.7	Clay loam				
3					5.5	3.1	13.4	39.1	38.4	Clay loam				
4					10.5	4.0	15.1	37.7	34.6	Clay loam				

Profile F3AU

Sarawak classification: G.S.G. Family Phase
 Red Yellow Podsollic Nyalau Shallow
 Location: Plot 1, Sample 171, Unit 3. Near Ng Serau, Gaat (see Map 3).
 Topography: Midslope of major ridge (gradient ca 30°).
 Parent material: Belaga Formation (Kapit member) sandstone.
 Vegetation: Mixed Dipterocarp Forest.

- 1/4-0 7.5YR 4/2 (dark brown) litter.
- 0-2 10YR 4/3 (dark brown) with few fine faint 2.5Y 8/4 (pale yellow) mottles, medium sandy loam, very weak fine subangular blocky, moist, soft to friable, slightly porous, abundant roots.
A1
- 2-10 10YR 7/8 (yellow) with few medium faint 5Y 8/4 (pale yellow) mottles; medium sandy loam to medium sandy clay loam, weak medium subangular blocky with weak discontinuous clayskins [10YR 7/4 (very pale brown)], moist, firm, very porous, many roots, scattered angular quartz grit, common patches of 7.5YR 5/4 (brown) and 10YR 5/2 (greyish brown) sandy loam in old root channels.
A2
 Clear slightly wavy boundary
- 10-19 As above but quartz decreases, plus few pieces of slightly hard 2.5YR 4/6 (red), 10YR 7/8 (yellow) and orange medium sandstone.
B
 Gradual wavy boundary
- 19-24 10YR 7/8 (yellow) with few medium faint 5Y 8/4 (pale yellow) mottles, medium sandy loam to medium sandy clay loam, moderate medium subangular blocky with strong discontinuous clayskins [10YR 7/6 (yellow)], moist, firm, very porous, many roots, many pieces of slightly hard to hard 2.5YR 4/6 (red) 10YR 7/8 (yellow) and orange sandstone.
 Gradual wavy boundary
- 24-34+ Slightly hard 2.5Y N8/ (white), 2.5YR 5/4 (reddish brown), 2.5Y 8/4 (pale yellow) and 5Y 8/4 (pale yellow) weathering sandstone with few patches of sandy clay loam (as in above horizon), much angular quartz grit.
 Gradual wavy boundary

Sample No.	Depth (ins.)	pH H 0 2	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III %	Ca	Mg	K	Na	CEC
1	0-2	3.8	2.5	0.26	170	100	310	2170	2.8	Tr	0.2	0.2	Tr	10.9
2	4-7	3.9	0.6	0.06	90	50	420	2360	4.3	Tr	0.1	Tr	Tr	3.9
3	10-19	4.2	0.2	0.03	50	90	470	3480	5.0	Tr	0.1	Tr	Tr	6.9
4	20-23	5.2	0.1	0.01	40	50	330	3900	4.5	Tr	Tr	Tr	Tr	3.0
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample 1					2.4	10.5	52.3	7.6	14.9	Sandy loam				
2					1.4	6.7	62.4	14.4	15.7	Sandy loam				
3					4.5	8.0	59.7	12.6	15.6	Sandy loam				
4					4.9	10.0	60.7	15.0	11.5	Stony sandy loam				

Profile F3AV ✕

Sarawak classification: G.S.G. Family Phase
 Skeletal Meluan Heavy
 Location: Plot 3, Sample 171, Unit 3. Near Ng. Serau, Gaat
 (see Map 3).
 Topography: Midslope of major ridge (gradient ca 40°).
 Parent material: Belaga Formation (Kapit member) sandstone and shale.
 Vegetation: Mixed Dipterocarp Forest.

¼-0 Litter.

0-2 5YR 5/4 (reddish brown), clay, moderate medium to fine subangular blocky with very weak discontinuous clayskins, moist, slightly firm, slightly plastic, non-sticky, slightly porous, many roots, few pieces of slightly hard 10YR 8/8 (yellow) and 2.5YR 5/6 (light red) mudstone.

Gradual regular boundary

2-8 5YR 6/6 (reddish yellow) with very few fine faint 5YR 7/8 (reddish yellow) mottles, fine sandy clay to clay, moderate medium subangular blocky with weak discontinuous clayskins (colour as matrix), moist, firm, slightly plastic, non-sticky, very porous, common roots, few stones - as in above horizon.

Clear wavy boundary

8-23 Colour and texture as in above horizon, structure dominated by stones but patches with weak medium subangular blocky with strong continuous clayskins especially against stones [colour as matrix], moist to slightly wet, plastic, slightly sticky; very porous, common abundant pieces of hard to slightly hard siltstone, mudstone and sandstone. Colours as in above horizon plus 2.5YR 5/4 (reddish brown).

Clear wavy boundary

23-46+ Very similar to above but proportion of soil decreases. Hard stones appear to be in situ, showing weak horizontal bedding. Soil as interlaminar films, but also some larger patches.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III %	Ca	Mg	K	Na	CEC
1	0-2	3.6	2.3	0.28	410	330	1230	11520	12.9	Tr	0.1	0.4	Tr	11.5
2	3-7	3.8	0.8	0.13	300	310	1380	12440	13.8	Tr	0.1	0.1	Tr	10.0
3	14-17	4.5	0.4	0.09	290	320	1170	12810	13.6	Tr	0.1	0.1	Tr	11.0
4	36-40	5.1	0.2	0.07	280	310	1530	13820	13.6	Tr	0.1	0.1	Tr	8.9
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample 1					4.6	2.9	9.1	41.0	40.2	Silty clay				
2					3.5	1.7	12.4	35.5	43.1	Clay				
3					3.0	1.7	10.1	36.9	47.9	Clay				
4					5.5	3.6	15.7	27.6	43.1	Clay				

Profile F3AW

Sarawak classification: G.S.G. Family Phase
 Skeletal Kapit Heavy
 Location: Plot 3, Sample 107, Unit 3. Sg. Melatai (see Map 3).
 Topography: Upper slope of main ridge (gradient ca 45°).
 Parent material: Belaga Formation (Layar member) sandstone and shale.
 Vegetation: Mixed Dipterocarp Forest.

1-0 Dark reddish brown litter.
 0-2 7.5YR 4/4 (dark brown), medium sandy clay loam, weak fine sub-
 angular blocky, moist, soft, slightly porous, abundant roots.

2-8 Clear wavy boundary
 7.5YR 6/8 (reddish yellow) with few fine faint 5Y 7/4 (pale yellow) mottles, medium sandy clay, moderate medium subangular blocky with moderate discontinuous clayskins especially along old root channel [7.5YR 7/8 (reddish yellow)], moist, firm, slightly porous, many roots, patches of 7.5YR 5/4 (brown) especially in old root channel, few pieces of slightly hard 10YR 4/3 (weak red), 7.5YR 7/8 (reddish yellow) and orange medium sandstone.

8-21 Gradual slightly wavy boundary
 7.5YR 6/6 (reddish yellow), medium sandy clay, moderate medium subangular blocky with moderate continuous clayskins [7.5YR 7/8 (reddish yellow)], moist, firm, slightly porous, many roots, many pieces of slightly hard to soft 10R 4/3 (weak red), 5Y 7/6 (yellow), 2.5Y 7/6 (yellow) and purple medium sandstone.

21-38 Gradual slightly wavy boundary
 As above with strong continuous clayskins [5YR 6/8 (reddish yellow)] with few root, stones as above but increase to abundant.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III%	Ca	Mg	K	Na	CEC
1	0-2	3.4	9.4	0.67	500	340	1510	3220	10.0	0.1	0.4	0.1	Tr	30.9
2	3-6	4.8	0.2	0.06	140	390	1820	5740	16.5	Tr	Tr	Tr	Tr	38.9
3	29-32	3.6	0.9	0.11	190	370	1900	3000	12.9	Tr	Tr	0.1	Tr	11.6
4	40-46	5.3	0.1	0.05	140	450	2190	5520	15.8	Tr	Tr	Tr	Tr	5.7

Sample	% of fine earth				Texture
	Clay	Silt	Fine sand	Coarse sand	
1	15.1	14.5	51.7	18.7	Sandy loam
2	9.2	19.0	36.7	34.9	Sandy loam
3	18.2	3.4	25.3	52.9	Sandy loam
4	12.4	14.8	32.4	39.9	Sandy loam

Profile 3AX

Sarawak classification: G.S.G. Family Phase
 Skeletal Kapit Heavy
 Location: Plot 4, Sample 133, Unit 3. Ulu Piat, Gaat (see Map 3).
 Topography: Upper slope of major ridge (gradient ca 45°).
 Parent material: Belaga Formation (? Kapit member) sandstone.
 Vegetation: Mixed Dipterocarp Forest.

¼-0 Dark reddish brown litter.

0-3 10YR 6/3 (pale brown), medium sandy clay loam, weak fine sub-
 angular blocky, moist, soft, slightly porous, abundant roots,
 A few pieces of soft to slightly hard 10YR 7/8 (yellow), 5Y 8/4
 (pale yellow) and 7.5YR 5/8 (strong brown) medium sandstone.

Clear gradual boundary

3-19 10YR 6/6 (brownish yellow), medium sandy clay loam, weak medium
 subangular blocky with weak discontinuous clayskins [10YR 5/4
 B (yellowish brown)] especially in old root channels, moist,
 slightly firm, porous, abundant roots, many pieces of soft to
 slightly hard 5Y 8/2 (white), 7.5YR 6/6 (reddish yellow), 7.5YR
 5/8 (strong brown), and 10R 6/8 (light red) medium sandstone,
 scattered fine charcoal.

Gradual slightly wavy boundary

19-27 10YR 6/8 (brownish yellow), medium sandy clay loam to medium
 sandy clay, weak medium subangular blocky with weak discontinuous
 clayskins [10YR 5/6 (yellowish brown)] especially against stones,
 moist, slightly firm, porous, many roots, many stones - colours
 as in above horizon.

Gradual wavy boundary

27-39+ Soil occurs as tongue in weathering rock. Mixed 10YR 5/6
 (yellowish brown) and 10YR 5/3 (brown) with many medium distinct
 5Y 6/1 (grey) and 2.5Y N7/ (light grey) mottles, medium sandy clay
 loam, weak medium subangular blocky with strong discontinuous
 clayskins [10YR 5/4 (yellowish brown)], moist, slightly firm, very
 porous, many roots, abundant stones - colours as in above horizon.
 Weathering rock is soft to slightly hard 7.5YR 6/6 (reddish yellow),
 7.5YR 5/8 (strong brown) and 10R 6/8 (light red) medium sandstone.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III%	Ca	Mg	K	Na	CEC
1	0-3	4.5	2.1	nd	120	10	810	1740	3.5	1.7	0.2	0.3	0.1	7.5
2	10-13	5.2	0.7	nd	70	10	940	2180	8.6	1.5	0.1	0.1	0.1	4.9
3	21-24	4.1	0.6	nd	80	10	1550	3540	6.5	1.8	0.1	0.1	0.1	7.4
4	36-39	3.9	1.1	nd	110	10	1300	2640	6.0	1.6	0.1	0.1	0.1	8.8
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample 1					4.0	8.5	51.9	14.6	18.1	Sandy loam				
2					5.7	10.5	56.2	19.0	9.8	Sandy loam				
3					3.1	7.6	55.3	8.4	18.2	Sandy loam				
4					2.6	6.3	52.4	16.8	12.4	Sandy loam				

Profile F3AY

Sarawak classification: G.S.G. Family Phase
 Red Yellow Podsollic Bekenu Deep
 Location: Plot 7, Sample 114, Unit 3. Ulu Mengiong (see Map 3).
 Topography: Crest of minor ridge.
 Parent material: Belaga Formation (Kapit member) sandstone and shale.
 Vegetation: Mixed Dipterocarp Forest.

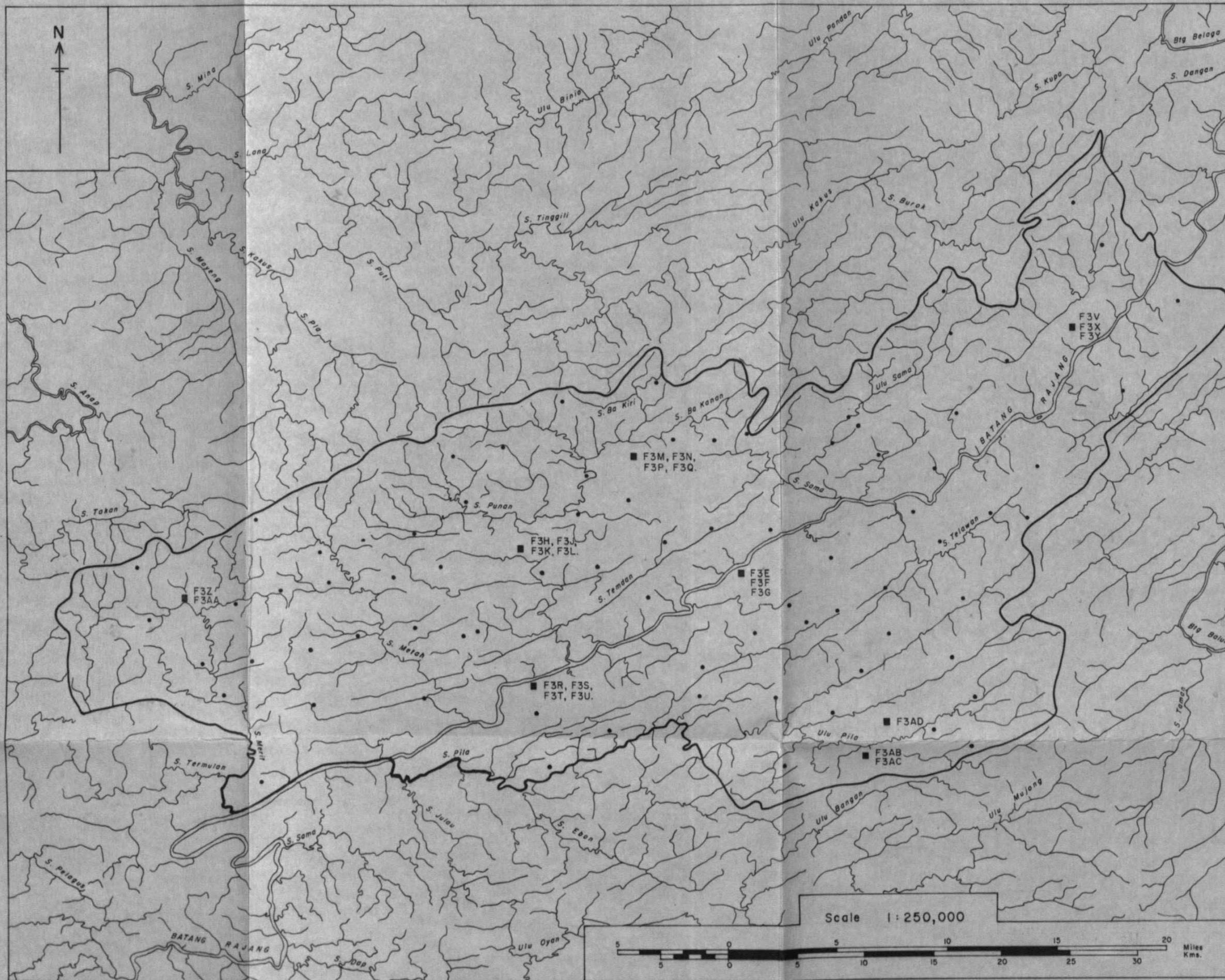
- ½-0 Dark reddish brown litter.
- 0-3 10YR 5/6 (yellowish brown) with few fine faint 2.5Y 7/4 (pale yellow) mottles, fine sandy clay loam, very weak fine subangular blocky, moist, soft, very porous, abundant roots.
 A1
- Clear regular boundary
- 3-9 10YR 6/8 (brownish yellow) with few fine faint 2.5Y 7/4 (pale yellow) mottles, fine sandy clay, weak fine subangular blocky, with weak continuous clayskins [10YR 7/6 (yellow)], moist, soft, very porous, many roots, patches of 10YR 5/3 (brown) sandy clay loam in old root channels.
 #2
- Gradual wavy boundary
- 9-14 Mixed distinct 5Y 7/4 (pale yellow), 7.5YR 6/8 (reddish yellow) and 5YR 4/8 (yellowish red), sandy clay, weak medium subangular blocky with weak continuous clayskins [10YR 6/6 (brownish yellow)], moist, slightly firm, slightly porous, many roots.
- Gradual wavy boundary
- 14-23 10YR 7/8 (yellow) with few fine faint 2.5Y 7/4 (pale yellow) mottles, fine sandy clay to clay, moderate medium subangular blocky with strong continuous clayskins [10YR 6/6 (brownish yellow)], moist, firm, non-porous, few roots, scattered quartz grit.
 B
- Diffuse boundary
- 23-38 10YR 7/8 (yellow) with many medium distinct 2.5Y 7/4 (pale yellow) mottles, medium sandy clay, moderate medium subangular blocky with strong continuous clayskins [10YR 6/8 (brownish yellow)], moist, firm, slightly porous, rare roots, but common patches of 2.5Y 5/2 (grey brown) in old root channels, many pieces of hard to slightly hard 2.5Y 7/6 (yellow), 10R 6/4 (pale red), 10R 4/3 (weak red) and 10YR 5/6 (strong brown) medium sandstone.
- Diffuse gradual boundary
- 38-48+ As above but stones harder. Stone colours become less red and more yellow.

Sample No.	Depth (ins.)	pH H ₂ O	% Org. C	% Total N	Conc. HCl Extract					Exchangeable me./100gms				
					P ppm	Ca ppm	Mg ppm	K ppm	Group III %	Ca	Mg	K	Na	CEC
1	0-3	3.3	4.0	0.36	280	270	1860	4140	9.3	Tr	0.1	0.2	Tr	21.7
2	4-8	3.6	1.3	0.15	200	300	2090	4570	10.2	Tr	Tr	0.1	Tr	14.8
3	10-13	3.8	0.8	0.12	160	320	2150	4290	10.8	Tr	Tr	Tr	Tr	10.2
4	17-20	4.5	0.2	0.08	150	320	2240	5520	12.3	Tr	Tr	Tr	Tr	9.2
5	29-33	4.9	0.2	0.07	130	390	1720	4640	11.9	Tr	Tr	Tr	Tr	7.1
6	40-44	5.3	0.1	0.06	140	420	1660	5540	13.2	Tr	Tr	Tr	Tr	6.1
					% of fine earth					Texture				
					Coarse sand	Medium sand	Fine sand	Silt	Clay					
Sample 1					1.7	3.2	28.5	16.8	49.9	Clay				
2					1.9	4.3	30.6	24.3	45.9	Clay				
3					1.9	3.7	28.6	26.9	38.6	Clay loam				
4					2.3	3.9	35.2	20.7	43.8	Clay				
5					5.4	3.4	35.5	22.9	35.0	Clay loam				
6					6.2	3.8	34.8	23.3	31.3	Clay loam				

UPPER RAJANG

UNIT I

Forest inventory samples and soil profiles.



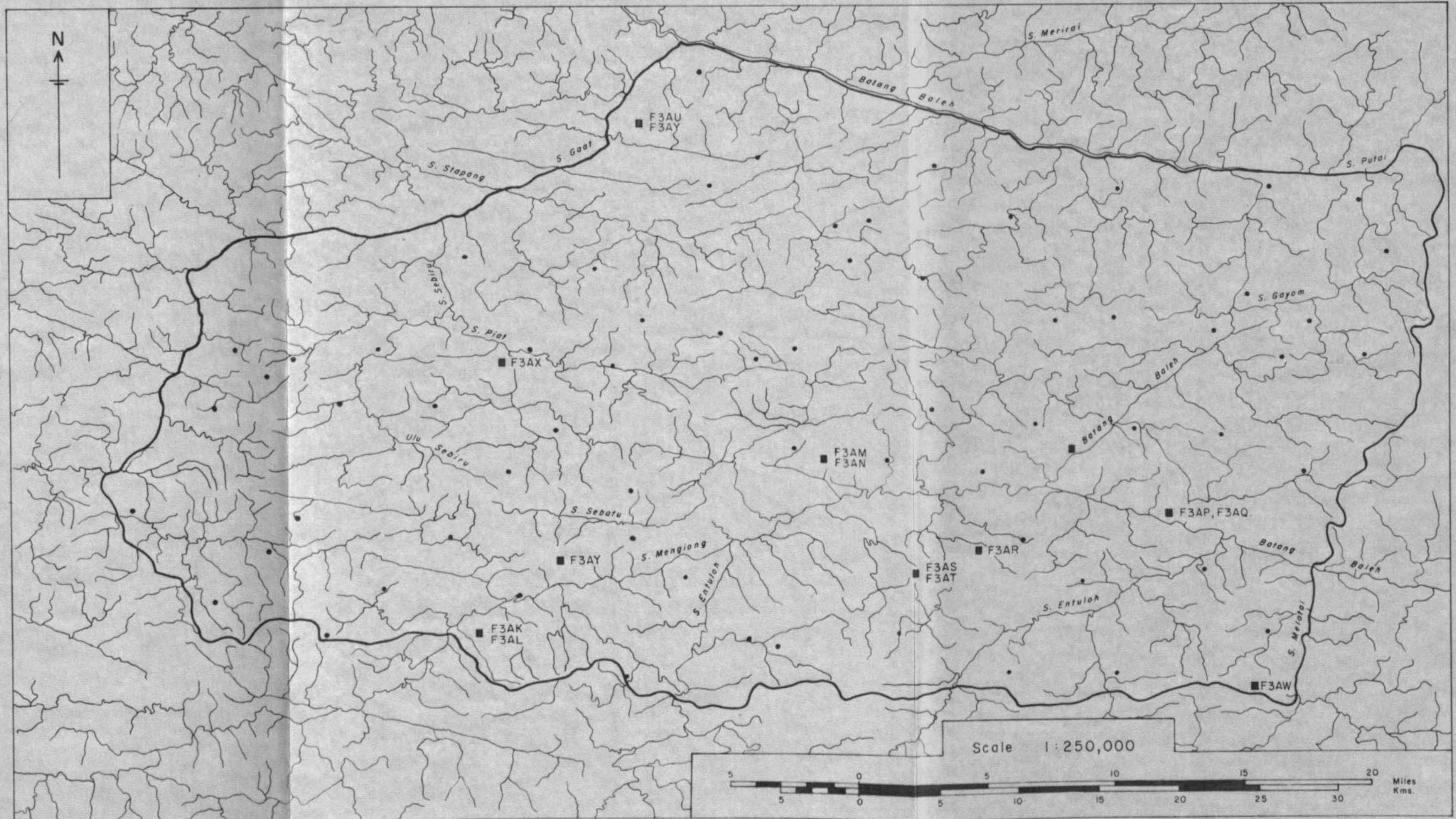
— Boundary of inventory unit.

■ Forest inventory sample, with soils data.
Numbers refer to soil profiles (see text).

• Forest inventory sample
(no soils data).

UPPER RAJANG UNIT 3

Forest inventory samples and soil profiles.



— Boundary of inventory unit.

■ Forest inventory sample, with soils data.
Numbers refer to soil profiles (see text).

• Forest inventory sample
(no soils data).

