NOTES ON SOIL CLASSIFICATION IN SARAWAK

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The present Notes on Soil Classification in Sarawak ~~aims~~ at providing a summary of the soils mapped in the State. Up to now, soil mapping has been conducted on a regional basis, each soil specialist being confined to soils of a particular region and in the process, a large number of soil units have been established quite independently and very often these soils are poorly correlated with soils mapped in other regions of the State. This state of ~~affairs~~ is partly the result of the urgent need to map soils for agricultural development purposes and the correlation of soils has been left unattended.

The soil units described have been summerised from two important sources, these are:-

(i) A Draft Reclassification of Soils in Central and North Sarawak by Scott (1973);

(ii) The Soils of West Sarawak by Andriesse (1972).

The formal classification of Sarawak soils was published in 1966 and this classification has remained in used since then. This classification classifies soils at the group and family level and is largely a genetic one. The publication of the 1967 Supplement to the USDA 7th Approximation introduced many diagnostic features which are useful for family classification and many of these diagnostic features are used in the classification of soils mapped in West Sarawak.

The classification presented here follows the soil groups as used in the 1966 Classification instead of the geomorphic-genetic grouping introduced by Scott (1973). The reason for this is that the concept of soil group is fairly well acquainted by most workers involved in soils in Sarawak and although some of the groups were not well defined, particularly the GREY-WHITE PODZOLICS AND RED-YELLOW PODZOLICS, it is hoped that the indequacies could be remedied by adopting parameters used in the 7th Approximation.

Within each group, family separation was based primarily on the textural groupings such as sands, loams and clays. This has resulted in the creation of some families for the intermediate textured soils which were not adequately defined in the 1966 Classification.

The definition of soil depth based on paralithic and lithic horizons has been found to be useful in Sarawak because of the large number of soils of residual origin which overly weathered rocks.

Improvement to definition of soils at the series and family level will depend on the greater use of analytical data, both chemical and physical and as these are absent or insufficient in many soils in Sarawak, classification of these soils will still be heavily dependent on soil parent material.

<u>Summary of Soils Mapped in Sarawak, 1975</u>

Group	Family	Series
I. RECENT ALLUVIAL SOILS		
I.1 Sands	KAYAN ~~SEMATAN~~ KABONG	Kayan Siar Kabong Siru Sematan Chupin Rambungan Belawai
I.2 Loams and Silts	BEMANG TERBAT	Bemang Similajau Nyabu Sebat Terbat
I.3 Clays	SEDUAU RAMUN	Seduau Malang Paku Sekati Entebar Ramun
II. SALINE GLEY SOILS		
II.1 Sands	BELAT ~~NONOK~~	Mersau, Pandau, Belak -
II.2 Loams and Silts	PALOH ~~SIRIK~~	Paloh Nangka, Nagor ~~Silik~~
II.3 Clays	RAJANG PENDAM	Rajang Pendam Jol
III. GLEY SOILS		
III.1 Sands	TATAU PLAN	Tatau, Telok, Nonou. ~~Matu~~ Plan ~~Luis~~
III.2 Loams and Silts	PAKAN	Pakan, Piasau, Sivik. ~~Gong~~
III.3 Clays	BIJAT SEMADO	Bijat Samarahan ~~Danau~~ ~~Punda~~ ~~Paya Megok~~ Mundai Kakai ~~Sebandi~~ ~~Krian~~ ~~Kluang~~ Semado ~~Gerawat~~ Bokah Embang

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Group	Family	Series
IV. **PODZOLS AND GROUNDWATER PODZOLS**	MIRI	Miri Bako
	BUSO	Buso Silantek
	JERIJEH	Pueh Stoh
V. **GREY-WHITE PODZOLICS**		
V.1 Sands	TIKA	Tika ✓ Kilong ✓
V.2.1 Loams	SARATOK	Saratok ✓ Penipah ✓ ~~Durin~~ Semeba.
V.2.2 Silts	BANDANG	Bandang ✓ Timang ✓
V.2.3 Loams and Silts - contrasting textures	TRIBOH	Triboh ✓ Kemunyang ✓
	LUBAI	Lubai ✓ ~~Sebaya~~ Marang
V.3 Clays	KERAIT	Kerait Ajoh Rukum Serayan Lingga
	Silio	Silio
	Latatan	Latan
VI. **RED-YELLOW PODZOLICS**		
VI.1 Sands	PENINJAU	Peninjau Sebaya
VI.2.1 Loams	NYALAU	Nyalau Matang Sabangang
VI. 2.2 Silts	BEKENU	Bekenu Sarikei Biawak Tukau

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I.2.1.d.	Fine silts, from alluvium derived from acid igneous rocks, biotite granite, with high content of mica and manganese; hue 10YR or yellower throughout control section (This series was formerly mapped within the <u>SEDUAU FAMILY</u> in West Sarawak because of its fine silty texture and the absence of an intermediate textural grouping where this series could be placed)	<u>Sebat</u>
I.2.2.	Loams and silts, all texture profiles except contrasting, formed from alluvium derived from intermediate to basic igneous rocks	<u>TERBAT FAMILY</u>
I.2.2.a.	Fine silts and coarse loams, hue 10YR or yellower increases to 7.5YR or redder in lower subsoil (<u>TERBAT FAMILY</u> was here established for the intermediate textured soils derived from alluvium of intermediate to basic igneous rocks; <u>Terbat</u> soils were formerly classed as a series in the clay textured <u>RAMUN</u> FAMILY of RECENT ALLUVIAL soil group)	<u>Terbat</u>
I.3.	<u>RECENT ALLUVIAL SOILS</u> - Clays	
I.3.1.	Clays, all textures except contrasting, derived from riverine alluvium of sedimentary and also from acid igneous rocks	<u>SEDUAU FAMILY</u>
I.3.1.a.	Clays, derived from riverine alluvium of seidmentary rocks, noncalcareous; hue 10YR or yellower throughout the upper 50 cm	<u>Seduau</u>
I.3.1.b.	Clays, derived from riverine alluvium of sedimentary rocks, noncalcareous, hue redder than 10YR in some horizon above 50 cm	<u>Malang</u>
I.3.1.c.	Clays, derived from alluvium of calcareous rocks; hue redder than 10YR above 50 cm	<u>Paku</u>
I.3.1.d.	Clays, derived from riverine alluvium of acid igneous rocks, biotite granite; hue 10YR or yellower throughout control section, mottled	<u>Sekati</u>
I.3.1.e.	Clays, derived from riverine alluvium of noncalcareous mudstone; hue redder than 10YR in upper 50 cm (This series was mapped within the <u>RAMUN FAMILY</u> which was characterised by hue redder than 10YR in upper 50 cm)	<u>Entebar</u>
I.3.2.	Clays, all textures except contrasting, derived from riverine alluvium of intermediate to basic igneous rocks	<u>RAMUN FAMILY</u>
I.3.2.a.	Clays, hue redder than 10YR in upper 50 cm (<u>RAMUN</u> FAMILY as mapped in West Sarawak includes four series but it is though that only one can be retained in this family while the <u>Siar</u> series is placed in the <u>KAYAN</u> FAMILY, <u>Terbat</u> series upgraded to a family and <u>Entebar</u> series placed in <u>SEDUAU</u> FAMILY)	<u>Ramun</u>

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II. SALINE GLEY SOILS

These are mineral soils in which:

1. An R or C horizon is not found within 25 cm of the base of an O horizon;
2. Groundwater conductivity exceeds 500 micromhos/cm at 25°C at some time of the year;
3. A gley horizon occurs within 50 cm of the base of an O horizon.

As mentioned in the 1966 classification and also in mapping in West Sarawak, the difficulty of mapping SALINE GLEY SOILS lies in the need for large number of conductivity measurements of groundwater samples and also because of the seasonal variation of groundwater conductivity levels. For this reason, the weakly saline soils can only be differentiated from the non-saline gley soils in semi-detailed or detailed mapping where large number of samples are taken for analysis. Soils with high salinity levels however, are commonly mapped by their association with definite vegetation types, namely mangrove and nipah.

The SALINE GLEY SOILS have been tentatively separated into the weakly saline families and the strongly saline families and the limit of 4,000 micromhos/cm at 25°C has been used to separate these families since 1966. In subsequent mapping in West Sarawak, this limit has been found to be acceptable but "in practise the vegetation is taken as a guide".* The ripening factor based on the N factor, with value of 0.5 has also been considered to be a possible limit, as the strongly saline gley soils were found generally to have N factor exceeding 0.5 while the weakly saline soils have N factor less than 0.5.

In more recent detailed mapping, it has been found that padi has been found to be growing fairly successfully on saline soils with groundwater conductivity level exceeding 5,000 micromhos/cm at 25°C while soils under nipah vegetation with groundwater conductivity level exceeding 6,000 micromhos/cm is seldom reclaimed for coconut or padi cultivation. It is therefore thought that the previous limit of 4,000 micromhos/cm could be raised to 5,000 to separate the weakly saline gley soils from the strongly saline gley soils.

pH KCl value of 3.5 of the dry soil can be also used to define the SALINE GLEY SOILS from the GLEY SOILS.

Texture Grouping

The texture grouping for SALINE GLEY SOILS are as follows:

1. Sands and loamy sands;
2. Loams and silts;
3. Clays.

II. SALINE GLEY SOILS - Sands and Loamy Sands

II.1.1. Sands, derived from alluvial processes, all texture profiles except contrasting; conductivity more than 500 micromhos/cm throughout the control section; pH KCl less than 3.5 in some horizon within 125 cm of the surface. — **BELAT FAMILY**

* The Soils of West Sarawak - Andriesse, J.P; 1972

II.1.2. Sands, derived from alluvial processes, all texture profiles except contrasting; conductivity more than 500 micromhos/cm in at least some part of the control section; pH KCl 3.5 or more in all horizons within 125 cm of the surface — NONOK FAMILY

II.2. SALINE GLEY SOILS - Loams and Silts

II.2.1. Loams and silts, derived from marine alluvium; all texture profiles except contrasting; conductivity more than 500 micromhos/cm throughout the control section; pH KCl less than 3.5 in some horizon within 125 cm of the surface — PALOH FAMILY

II.2.1.a. Fine silt, no surface peat present — Paloh

II.2.2. Loams and silts, derived from marine alluvium; all texture profiles except contrasting; conductivity more than 500 micromhos/cm in some part of the control section; pH KCl 3.5 or more in all horizons within 125 cm of the surface — SIRIK FAMILY

II.2.2.a. Fine silts, no surface peat present — Sirik

II.3. SALINE GLEY SOILS - Clays

II.3.1. Clays, conductivity more than 500 micromhos/cm in some horizons within 125 cm from the surface; pH KCl more than 3.5 throughout the control section — PENDAM FAMILY

II.3.1.a. Clays, no surface peat present (PENDAM FAMILY soils were formerly mapped mainly on their association with vegetation and land use; extensive areas of PENDAM soils have been cultivated under padi and coconut and many areas have now been requested for semi-detailed surveys for padi schemes. It is hoped that the analysis of the large number of soil and water samples collected in the course of these investigations would assist the definition of this important soils more precisely. Thus, the depth phase of non-saline to saline horizon, the salinity level and the presence and absence of potential acid-sulphate horizon within the control section shown tentatively in Table II.2b. could be important limits in the detailed characterisation of this family for agricultural use) — Pendam

II.3.2. Clays, conductivity more than 500 micromhos/cm in some horizon within 125 cm from the surface; pH KCl less than 3.5 in some horizon within the control section. — RAJANG FAMILY

II.3.2.a. Clays, no surface peat present (RAJANG FAMILY soils are potentially acid-sulphate and it may be possible to separate those soils which have high acid-sulphate potential, characterised by high sulphur and low calcium and those soils which do not develop into acid-sulphate soils on oxidation. In West Sarawak, Santubong series has been proposed for those soils with high acid-sulphate potential) — Rajang

III. GLEY SOILS

GLEY SOILS are mineral soils in which:

1. An R or C horizon is not within 25 cm of the base of an O horizon;
2. Any peaty O horizon is not more than 25 cm in thickness;
3. A gley horizon is present within 50 cm of the base of an O horizon;
4. Groundwater conductivity does not exceed 500 micromhos/cm at 25°C at any time of the year;
5. There is no spodic horizon;
6. There is no hardened plinthite.

Texture Grouping

The texture grouping of the GLEY SOILS is as follows:

1. Sands and loamy sands;
2. Loams and silts;
3. Clays.

In the 1966 Classification, only two textural groups were recognised - the light texture and the fine texture as medium textured soils were not thought to be significant. However, GLEY SOILS with loam and silt textures, though localised, nevertheless do occur. Another modification to the GLEY SOILS defined in the 1966 Classification is that surface peat is no longer considered a differenting characteristic at the family level: some families differentiated on the basis of the surface peat are now downgraded to the series level.

III.1.	GLEY SOILS - Sands and Loamy Sands	
III.1.1.	Sands and loamy sands, marine parent material	TATAU FAMILY
III.1.1.a.	No surface peat present	Tatau
III.1.1.b.	Surface peat present	Matu
III.1.2.	Sands and loamy sands, all texture profiles except contrasting, riverine parent material	PLAN FAMILY
III.1.2.a.	No surface peat present	Plan
III.1.2.b.	Surface peat present (Scott's Classification emphasises the hue of the horizons above 75 cm of the control section and proposes that hue be used as the differentiating feature at the family level instead of parent material as shown above)	Luis

III.2.	GLEY SOILS - Loams and Silts	
III.2.1.	Loams, all texture profiles except contrasting; riverine alluvium or colluvium	PAKAN FAMILY
III.2.1.a.	Coarse loams, hue light grey or grey but not greenish grey; no surface peat	Pakan
III.2.1.b.	Coarse loams, hue light grey or grey but not greenish grey, surface peat present	-----
III.2.1.c.	Fine silt; hue light grey or grey but not greenish grey; no surface peat	-----
III.2.1.d.	Fine silt; hue light grey to grey but not greenish grey; surface peat present	-----
III.2.1.e.	Coarse loams; old alluvium parent material; hue light grey to grey but not greenish grey; surface peat absent (This series was formerly mapped within the TATAU FAMILY in West Sarawak)	Gong
III.3.	GLEY SOILS - Clays	
III.3.1.	Clays, alluvial parent material	BIJAT FAMILY
III.3.1.a.	Clays, riverine alluvium, noncalcareous; hue light grey or grey throughout control section of 125 cm, no surface peat	Bijat
III.3.1.b.	Clays, riverine alluvium, noncalcareous; hue light grey to grey increases to greenish grey within 50 cm of the control section; no surface peat	Samarahan
III.3.1.c.	Clays, riverine alluvium, noncalcareous; hue light grey or grey increases to dark grey within 50 cm of the control section; no surface peat	Danau
III.3.1.d.	Clay, riverine alluvium mixed with old marine alluvium; hue light grey or grey increases to dark grey below 50 cm; potential acid-sulphate horizon present below 50 cm of the surface; no surface peat	Punda
III.3.1.e.	Clay, riverine alluvium from limestone, shale and basic igneous rocks; hue light grey or grey but not greenish grey or dark grey; no surface peat	Paya Megok
III.3.1.f.	Clays, riverine alluvium from limestone; hue light grey or grey but not greenish grey or dark grey; no surface absent (This series was formerly mapped within the TATAU FAMILY in West Sarawak; possibly correlated with the Paya Megok series)	Mundai

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III.3.1.g.	Clay, riverine alluvium from intermediate and basic igneous rocks; hue dark grey but not greenish grey below 50 cm; iron and manganese concretions common in B horizon, no surface peat	<u>Kakai</u>
III.3.1.h.	Clay, riverine alluvium, noncalcareous; hue light grey or grey but not dark grey or greenish grey; surface peat present	<u>Sebandi</u>
III.3.1.i.	Clay; riverine alluvium with some limestone influence; hue light grey or grey but not greenish grey or dark grey; iron concretions in the B horizon; surface peat present	<u>Krain</u>
III.3.1.j.	Clay or sandy clay, mixed riverine and marine alluvium; hue grey or dark grey and potential acid-sulphate horizon present below 50 cm from the surface; surface peat present	<u>Kluang</u>
III.3.2.	Clays, residual, colluvial or old alluvial parent material	<u>SEMADOH FAMILY</u>
III.3.2.a.	Clay, residual parent material, sedimentary rocks; hue pallid within 50 cm from the surface; surface peat absent, occur on long gentle dip slopes with poor drainage	<u>Semado</u>
III.3.2.b.	Clay, residual parent material, sedimentary rocks; hue pallid within 50 cm from the surface; surface peat present; occur on long gentle dip slopes with poor drainage; (This series was formerly mapped as a family in West Sarawak)	<u>Gerawat</u>
III.3.2.c.	Clay or sandy clay, stratified, or bisequent; mixed colluvial and residual parent material; hue pallid throughout control section; no surface peat; occur on foot of long gentle dip slopes with poor drainage	<u>Bokah</u>

IV. PODZOLS

PODZOLS are mineral soils in which

1. An R or C horizon is not within 25 cm of the base of the O horizon;
2. There is a spodic horizon.

In the 1966 Classification, definitions of PODZOLS include the presence of an albic horizon and groundwater periodically in the A2 or the B horizon but these are not considered necessary since podzols are characterised by the presence of a spodic horizon.

PODZOLS in Sarawak are differentiated into those with Bh horizon and those with Bir horizon.

IV.1.	Spodic horizon is Bh and is sufficiently cemented that cannot be penetrated by an Edelman auger	MIRI FAMILY
IV.1.1.	Alluvial parent material	Miri
IV.1.2.	Residual; sedimentary parent material	Bako
IV.2.	Spodic horizon is Bh but can be penetrated by an Edelman auger	BUSO FAMILY
IV.2.1.	Alluvial parent material	Buso
IV.2.2.	Sedimentary parent material	Silantek
IV.3.	Spodic horizon is Bir,	JERIJEH FAMILY
IV.3.1.	Spodic horizon is 7.5YR, alluvial parent material	Pueh
IV.3.2.	Spodic horizon is 10YR, alluvial pareht material	Stoh

(In Central Sarawak, Scott has indicated that the following series are possible in the BUSO FAMILY: Tunggal, Banyut, Grang, Bakau, Metading and Daup. It is proposed that more analytical data on 15-bar water retention, per cent extractable by pyrophosphate-dithionite solution will have to be relied on to identify the spodic horizon in these soils)

V. GREY-WHITE PODZOLICS:

These are mineral soils in which:

1. An R or C horizon is not within 25 cm of the base of an O horizon;
2. There is no gley horizon within 50 cm of the base of an O horizon;
3. There is no spodic horizon;
4. Chromas are 3 or less in the A2 horizon, 4 or less in the B horizon; hues are more yellow than 2.5Y in the A2 and B horizon; values are 6 or more in the A2 and B horizons.

The GREY-WHITE PODZOLICS are differentiated from the RED-YELLOW PODZOLICS mainly by the colour and analytical data shows that this is caused only by the difference of the iron content. GREY-WHITE PODZOLICS generally have 6NHCl extractable iron of less than 1% and for RED-YELLOW PODZOLICS, the extractable iron content is generally more than 2%. Scott has proposed intergrates between these soil groups based on the colour and further studies would be required to show the relationship between iron content, colour and other properties important to classification at this level.

Texture Grouping

The texture grouping for GREY-WHITE PODZOLICS is as follows:

1. Sands and loamy sands;
2. Loams;
3. Silts;
4. Clays.

This shows an increase of two textural groups over the two groups of the 1966 Classification which comprises fine and coarser than fine textures only.

V.1. GREY-WHITE PODZOLICS - Sands and Loamy Sands

V.1.1. Sands, all texture profiles except contrasting — TIKA FAMILY

V.1.1.a. Sands, alluvial parent material; hue pallid throughout control section — Kilong

(This is the giant podzols with Bh horizon occuring at least 125 cm below the surface; these soils occur on sub-recent terraces in the First and Fourth Divisions; Bintulu series as proposed by Scott is now cancelled)

V.1.1.b. Sands, sedimentary parent material; hue pallid throughout control section — Tika

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V.2.	GREY-WHITE PODZOLICS - Loams	
V.2.1.	Loams, all texture profiles except contrasting	SARATOK FAMILY
V.2.1.a.	Coarse loams, sedimentary parent material; hue pallid throughout control section	Saratok
V.2.1.b.	Coarse loams, sedimentary parent material; hue pallid in upper 50 cm and variegated in lower part of control section	Penipah
V.2.1.c.	Fine loams, sedimentary parent material; hue pallid throughout control section	Durin
V.2.2.	Fine silt; all texture profiles except contrasting; sedimentary parent material	BANDANG FAMILY
V.2.2.a.	Hue pallid throughout control section	Badang
V.2.2.b.	Hue variegated below 50 cm	Penipah
V.2.3.	Coarse loams in upper subsoil, alluvial parent material; texture contrast within 75 cm from the surface	TRIBOH FAMILY
V.2.3.a.	Colluvial and alluvial parent material; hue pallid throughout control section	Triboh
V.2.3.b.	Alluvial or colluvial parent material; over sedimentary rocks; hue pallid throughout control section	Kemunyang
V.2.4.	Fine silt in upper subsoil; alluvial parent material; texture contrast within 75 cm from the surface	LUBAI FAMILY
V.2.4.a.	Old alluvial parent material; hue pallid throughout control section	Lubai
V.2.4.b.	Old alluvium admixed with chert; hue pallid throughout control section	Merang
V.3.	GREY-WHITE PODZOLICS - Clays	
V.3.1.	Clays, all texture profiles except contrasting	KERAIT FAMILY
V.3.1.a.	Clay; sedimentary parent material, carbonaceous shale; hue pallid throughout control section	Kerait
V.3.1.b.	Clay; sedimentary parent material, carbonaceous shale; hue variegated below 50 cm	Ajoh
V.3.1.c.	Clay; sedimentary parent material, phyllite or chert; hue pallid-bluish grey throughout control section	Rukum
V.3.1.d.	Clay, sedimentary parent material, chert; hue pallid-pinkish grey throughout control section	Serayan
V.3.1.e.	Clay; acid igenous parent material, microgranite; hue pallid throughout control section	Lingga

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VI. RED -YELLOW PODZOLICS

These are mineral soils in which:

1. An R or C horizon is not found within 25 cm of the base of an O horizon;
2. Chromas are 5 or more in the B horizon, hues are 2.5Y or redder in the B horizon, values are 5 or less in the B horizon;
3. There is no gley horizon within 50 cm of the base of the O horizon;
4. There is an A2 (possibly albic) horizon over an argillic horizon;
5. If a Bir horizon is present, there is no gley horizon within 125 cm of the base of the O horison.

The RED-YELLOW PODZOLICS soil group has been studied in more detail in West Sarawak than in other part of the State. The definitions for this soil group as given in the 1966 Classification have been criticised with regard to:

1. The presence of an argillic horizon in soils of this group has not found to be conclusive although increase in clay content with depth in most soils has been observed. Micropedological studies to investigate the presence or absence of oriented clay would be needed;
2. The CEC values and the amount of weatherable clays in some of these soils have been to be too high;
3. Data on particle size analysis are insufficient and more analysis on the fine clay and coarse clay would be needed.

Texture Grouping

The texture grouping is as follows:

1. Sands and loamy sands;
2. Loams and silts;
3. Clays.

Soils with contrasting textures have not been mapped for this soil group.

VI.1. RED-YELLOW PODZOLICS Sands and Loamy Sands

VI.1.1. Sands and loamy sands; all texture profiles except contrasting — PENINJAU FAMILY

(This is a new family introduced for this texture group in 1973)

VI.1.1.a. Sedimentary parent material, coarse sandstone; hue 10YR or yellower throughout control section — Peninjau

VI.1.1.b. Alluvial parent material; hue 10YR or yellower throughout control section — Sebaya

VI.2. RED-YELLOW PODZOLICS - Loams and Silts

VI.2.1. Coarse loams, all texture profiles except contrasting — NYALAU FAMILY

VI.2.1.a.	Coarse loams; sedimentary parent material, sandstone, noncalcareous; hue 10YR or yellower above 50 cm	Nyalau
VI.2.1.b.	Coarse loams; sedimentary parent material, noncalcareous; hue 10YR or yellower throughout control section; possibly with weak albic horizon present (Matang series was mapped as a family in West Sarawak; these soils are very localised but if the albic horizon is clearly recognised, this series needs to be placed in a higher level)	Matang
VI.2.1.c.	Coarse loams; old alluvium; hue 10YR or yellower throughout control section	Sabangang
VI.2.2.	Silts, all textures except contrasting	BEKENU FAMILY
VI.2.2.a.	Silts, sedimentary parent material, sandy shale, noncalcareous; hue 10YR or yellower above 50 cm (Scott suggested Bekenu series should be defined as having a CEC/clay of 16 or less in some part of the control section, implying the presence of an oxic horizon in some part of the control section)	Bekenu
VI.2.2.b.	Silts; sedimentary parent material, sandy shale; hue redder than 10YR throughout the control section	Sarikei
VI.2.2.c.	Silts; sedimentary parent material, greywacke sandstone; hue 10YR or yellower throughout the control section	Biawak
VI.2.2.d.	Silts; old alluvial parent material; hue 10YR or yellower above 50 cm	Tukau
VI.3.	RED-YELLOW PODZOLICS - Clays	
VI.3.1.	Clays; acid igneous and sedimentary rocks, Group III oxides more than 20% in some horizon within the control section	ABOK FAMILY
VI.3.1.a.	Clay; parent material acid igneous rocks, microgranodiorite; hue 10YR or yellower throughout control section	Abok
VI.3.1.b.	Clay or sandy clay; parent material schist; hue 10YR or yellower throughout control section	Bayur
VI.3.1.c.	Clay; parent material hornfels and tonalits; hue 10YR throughout control section	Gumbang
VI.3.1.d.	Sandy clay; parent material granite and granodiorite; hue redder than 10YR in the subsoil of the control section (This series has Group III oxides less than 20% and based on this parameter alone, this series would not qualify as a series of the ABOK FAMILY)	Gading

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VI.3.1.e.	Sandy clay; parent material granite or granodiorite; hue redder than 10YR in the subsoil of the control section (This series is very similar to the Gading series, both being derived from coarse grained acid igneous rocks, with sandy clay texture and Group III oxides less than 20% in all horizon of the control section)	Jagoi
VI.3.1.f.	Clay, parent material silicified volcanics, tuffaceous; hue redder than 7.5YR throughout the control section, mainly red	Keladan
VI.3.1.g.	Clay, parent material arkose; hue 10YR throughout control section	Serin
VI.3.2.	Clays, all texture profiles except contrasting; noncalcareous sedimentary or alluvial parent material; pH H_2O less than 6.0 in all horizons below a depth of 75 cm or immediately above a paralithic or lithic contact if shallower than 75 cm; Group III oxides less than 20% in all horizons within the control section	MERIT FAMILY
VI.3.2.a.	Clay; parent material carbonaceous shale, pyritic; hue 10YR or yellower, subsoil pallid, quarts and concretions stoneline in lower subsoil; CEC/clay less than 16	Bedup
VI.3.2.b.	Clay; parent material carbonaceous shale, pyritic; hue 10YR or redder, with grey mottles in subsoil; CEC/clay more than 16 in some horizon within the control section	Semongok
VI.3.2.c.	Clay; parent material carbonaceous shale; hue yellower than 10YR; CEC/clay more than 16 in some horizon within the control section (This series is closely related to the Semongok series except for the colour)	Padawan
VI.3.2.d.	Clay; parent material red mudstone; hue redder than 7.5YR throughout the control section; CEC/clay less than 16 throughout the control section	Begunan ? Dif from Rapak
VI.3.2.e.	Clay; parent material purplish mudstone; hue redder than 7.5YR below 50 cm; lower subsoil strongly variegated; CEC/clay less than 16 in all horizons throughout the control section	Stom
VI.3.2.f.	Clay; parent material shale; hue 10YR throughout the control section; CEC/clay less than 16 in all horizons of the control section; (On the basis of the high content of Group III oxides, this series should be placed in the ABOK FAMILY)	Melugu

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VI.3.2.g. Clay; parent material shale; hue redder than 7.5YR within 50 cm of the surface; CEC/clay more than 16 and Group III oxides more than 20% in some horizon within the control section — **Rapak** diff. from Beguran

(As with the Melugu series, Rapak series could be placed in the ABOK family because of the high content of Group III oxides; this series was classified as a family in the GROUNDWATER LATERITES soil group in the 1966 Classification)

VI.3.2.h. Clay; parent material shale with limestone influence; hue redder than 10YR in some part of the control section within 50 cm; CEC/clay more than 16 in some horizon within the control section — **Stass**

VI.3.2.i. Clay; parent material shale; hue 10YR or yellower in some part of the control section above 50 cm; CEC/clay less than 16 and Group III oxides less than 20% in all horizons — **Merit**

VI.3.2.j. Clay; parent material shale; hue redder than 10YR throughout the control section; CEC/clay less than 16 and Group III oxides less than 20% in all horizons of the control section — **Jakar**

VI.3.2.k. Clay; parent material old alluvium; hue 10YR or yellower in some part of the control section above 50 cm; CEC/clay less than 16 and Group III oxides less than 20% in all horizons of the control section — **Lupar**

VI.3.3. Clays, all texture profiles except contrasting; parent material acid igneous rocks; soils have strong affinities with those of ABOK FAMILY; mapped in Central Sarawak and presently undifferentiated at the family level — NOW IN ABOK.

VI.3.3.a. Clay; parent material granite or granodiorite; hue redder than 10YR throughout the control section; CEC/clay less than 16 throughout the control section — **Changgan**

VI.3.3.b. Fine silt; parent material rhyolite and acid igneous rocks; hue redder than 10YR throughout the control section; CEC/clay more than 16 in some horizon within the control section — **Arip**

VI.3.3.c. Clay; parent material probably similar to those of Arip series; hue 10YR or yellower throughout the control section; CEC/clay less than 16 in all horizons of the control section — **Nyaroh**

VI.3.3.d. Clay; parent material quartz-biotite hornfels or related acid igneous or metamorphics; hue redder than 10YR throughout the control section; CEC/clay less than 16 in all horizons of the control section — **Firing**

VII. BROWN FOREST SOILS

These are mineral soils in which:

1. There is no C or R within 25 cm of the base of an O horizon;
2. The base saturation is more than 35 per cent and pH H_2O more than 6.0 in some horizon below a depth of 75 cm or immediately above a lithic or paralithic contact is shallower than 75 cm;
3. There is no gley horizon within 50 cm of the base of the O horizon.

VII.1. BROWN FOREST SOILS - Clays

VII.1.1. Clays, all texture profiles except contrasting; sedimentary parent material, calcareous shale or marl; Group III oxides less than 20% — KABULOH FAMILY

VII.1.1.a. Clay, hue 2.5Y or yellower throughout the control section; base saturation and per cent calcium saturation more than 50; pH H_2O more than 6.0 in some part of the control section above 50 cm; CEC/clay more than 16 in some horizon of the control section — Kabuloh

VII.1.1.b. Clay; hue 10YR or yellower increasing to 7.5YR or redder in the lower part of the control section; base saturation and per cent calcium saturation less than 50 in the upper part of the control section, increasing to more than 50 at depth; pH H_2O more than 6.0 immediately above paralithic or lithic horizon; CEC/clay more than 16 in some horizon of the control section — Karabangan

VII.1.1.c. Clay; hue 10YR increasing to 7.5YR or redder in the upper subsoil, lower subsoil variegated; only paralithic horizon has base saturation and per cent calcium more than 50 and pH H_2O more than 6.0; CEC/clay less than 16 in all horizons of the control section — Tangap

(Tangap series is generally deep and paralithic or lithic horizon is rarely met within the control section; this series is very similar to the mottled phase of Jakar series of MERIT FAMILY but the calcareous nature of the parent material is certain; this series may be considered as an intergrade between the MERIT FAMILY and KABULOH FAMILY)

KABULOH FAMILY is the only family identified in the BROWN FOREST SOILS, a light textured family, the KEDADUM FAMILY was included in the 1966 Classification but this has not been mapped.

VIII. LATERITIC SOILS

These are mineral soils in which:

1. There is no C or R horizon within 25 cm of the base of the O horizon;

2. The content of Group III oxides is more than 25% in the A2 and horizons;

3. Colours have chromas 4 or more in A2 and B horizons;

4. There is no gley horizon within 50 cm of the base of an O horizon;

5. There is no hardened plinthite.

The second definition for LATERITIC SOILS, Group III oxides more than 25%, could be better replaced by 6NHCl extractable iron oxides since the content of Group III xoides in some soils is due largely to aluminium oxides.

Texture Grouping

Only the clay textured group is mapped in this soil group.

VIII.1.	LATERITIC SOILS - Clays	
VIII.1.1.	Clays, all texture profiles except contrasting; parent material intermediate to basic igneous rocks	TARAT FAMILY
VIII.1.1.a.	Clays; parent material intermediate acid igneous, andesitic; hue redder than 7.5YR throughout the control section, mainly 2.5YR, red; CEC/clay less than 16; deep soil and kaolinitic clay dominant	Tarat
VIII.1.1.b.	Clays; parent material basic igneous, basalt; hue 7.5YR throughout the control section; CEC/clay less than 16; shallow soil and gibbsite common in clay	Bukit Batu
VIII.1.1.c.	Clays; parent material porphoritic andesite; hue 10YR throughout the control section; CEC/clay more than 16; deep soil	Antayan
VIII.1.1.d.	Clays; parent material basic igneous, gabbro; hue 7.5YR throughout the control section; CEC/clay less than 16; shallow soil and gibbsite common in clay	Jebong
VIII.1.1.e.	Clays; parent material silicified basic volcanics; hue redder than 10YR in some horizon above 50 cm; CEC/clay less than 16; deep soil	Sejinkat

IX. SKELETAL SOILS

These are mineral soils in which an R or C horizon is ~~not~~ present within 25 cm of the base of an O horizon.

Texture Grouping

No texture grouping is defined for this soil group, but textures are mainly loams and clays.

IX.1.1.	Clays or loams; residual or alluvial parent material with lithic horizon present within 25 of the surface, if this mineral horizon overlies paralithic horizon, the lithic horizon is present within 50 cm from the surface	MELUAN FAMILY
IX.1.2.	Clays or loams; residual parent material of basic igneous rocks; soil horizon less than 25 cm overlying paralithic horizon; lithic horizon not present within 50 cm from the surface; total phosphorus more than 500 ppm	SEDONG FAMILY
IX.1.2.a.	Clay loams or clays; hue 10YR	Suka
IX.1.3.	Clays; residual parent material from sedimentary and acid igneous rocks; soil less than 25 cm overlying paralithic horizon; lithic horizon not present within 50 cm from the surface; total phosphorus less than 500 ppm	KAPIT FAMILY
IX.1.3.a.	Clays; parent material sedimentary rocks	Kapit
IX.1.3.b.	Clays; parent material acid igneous rocks	Buri
IX.1.4.	Clays or loams; alluvial parent material overlying weathered sedimentary rocks lithic horizon not present within 50 cm	BINATANG FAMILY
IX.1.4.a.	Clays or loams; hue 10YR or yellower, imperfect to well drained	Binatang
IX.1.4.b.	Clays or loams; hue pallid, poorly drained	Kelupu
IX.1.5.	Matrix of coarse and fine; parent material colluvial and alluvial, of hard cobbles and sandstone corestones	GAYA FAMILY
IX.1.5.a.	Sands and silts derived from sandstone and granite parent material	Lundu

X. PEAT SOILS

These are soils with 35 per cent or more of organic matter and is more than 25 cm deep. Soils with organic horizon less than 25 cm thick are classed in the GLEY SOILS or SALINE GLEY SOILS.

Families of PEAT SOILS are differentiated by the thickness of the peat layer and the nature of the mineral substratum.

X.1.	Soils with 35 per cent or more of organic matter, 25-100 cm thick, overlying sands	IGAN FAMILY
X.2.	Soils with 35 per cent or more of organic matter, 25-100 cm thick, overlying clays	MUKAH FAMILY
X.2.1.	Soil with more than 65 per cent organic matter residual origin; conductivity of all organic and mineral horizons less than 500 micromhos; pH KCl of mineral horizons 3.5 or more within 125 cm of the surface	Mukah peat
X.2.2.	Soils with more than 65 per cent organic matter, residual origin; conductivity more than 500 micromhos; pH KCl less than 3.5 in some mineral horizon within 125 cm of the surface	Patok
X.2.3.	Soil with more than 65 per cent of organic matter, alluvial origin; conductivity of all organic and mineral horizons more than 500 micromhos; pH KCl less than 3.5 in some mineral horizon within 125 cm of the surface	Mahat
X.2.4.	Soils with more than 35 but less than 65 per cent organic matter, residual origin; conductivity of all organic and mineral horizons less than 500 micromhos; pH KCl of mineral horizons 3.5 or more throughout surface 125 cm	Epai - muck
X.2.5.	Soils with more than 35 but less than 65 per cent organic matter, residual origin; conductivity of all organic and mineral horizons more than 500 micromhos; pH KCl 3.5 or more throughout surface 125 cm	Merapok
X.3.	Soils with 35 per cent or more of organic matter, deeper than 100 cm	ANDERSON FAMILY
X.3.1.	Soils with more than 65 per cent organic matter, residual origin; conductivity of all horizons within 125 cm of the surface less than 500 micromhos; pH KCl of any mineral horizon within this depth 3.5 or more	Anderson
X.3.2.	Soils with more than 35 per cent but less than 65 per cent organic matter, residual origin; conductivity of all horizons within 125 cm of the surface less than 500 micromhos; pH KCl of any mineral horizon within this depth 3.5 or more	Gadong

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X.3.3. Soils with more than 35 per cent organic matter, residual origin; conductivity more than 500 micromhos in some horizon within 125 cm of the surface; pH KCl 3.5 or more in some horizon within 125 cm from the surface <u>Limbang</u>

X.3.4. Soils with more than 35 per cent organic matter, alluvial origin; conductivity of all horizons within 125 cm of the surface more than 500 micromhos; pH KCl of any mineral horizons within this depth less than 3.5 <u>Luk</u>

(The depth phases for series of ANDERSON FAMILY are as follows: Anderson 1: 100-200 cm,
Anderson 2: 200-300 cm,
Anderson 3: more than 300 cm)

Table 1.1 RECENT ALLUVIAL SOILS: SANDS AND LOAMY SANDS

Family	Series	Parent Material	Texture	Hue	Topography, Type Locality	Diagnostic Features	Correlation Status
KAYAN	Kayan	Riverine alluvium from sedimentary rocks	Sand, loamy sands	10YR or yellower in upper 50 cm	Levee alluvium	Hue, parent material	Mapped throughout Sarawak
	Siar	Alluvium from adamellite or gabbro	Sands, loamy sands	Redder than 10YR over 10YR or yellower	Alluvial flat, Bukit Gading, Lundu	Hue, parent material	Mapped locally in Lundu Area, West Sarawak only
SEMATAN	Kabong	Marine alluvium	Sands	Hue 10YR or yellower in upper 50 cm	Present storm beach	Hue, topography	Mapped locally throughout coastal Sarawak
	Siru	Marine alluvium with high mica and hornblende				Hue, parent material, topography	Mapped locally in West Sarawak only
	Sematan	Marine alluvium	Sands	Redder than 10YR in some horizon above 50 cm	Subrecent beach	Hue	Mapped in West Sarawak only
	Chupin			10YR or yellower in surface 50 cm		Hue, shell layer within control section	Mapped in West Sarawak as a series of SEMATAN family
	Rambungan			Redder than 10YR in some horizon above 50 cm		Hue, manganese rich B-horizon	Mapped in West Sarawak as a series of SEMATAN family
	Belawai			Redder than 10YR in upper 50 cm	Subrecent beach (?)	Hue	Mapped in Central Sarawak, possibly correlated with Sematan or Rambungan series or with JERIJEH family in West Sarawak

Table 1.2 RECENT ALLUVIAL SOILS: LOAMS AND SILTS

Family	Series	Parent Material	Texture	Hue	Topography, Type Locality	Diagnostic Features	Correlation Status
BEMANG	Bemang	Alluvium from sedimentary rocks, mainly shale	Fine silts	10YR or yellower in upper 50 cm	Levee alluvium	Hue, texture	Mapped in North and Central Sarawak
	Similajau	Alluvium from sedimentary rocks, shale and sandstone	Coarse loams	10YR or yellower in upper 50 cm			Mapped throughout Sarawak
	Nyabu	Alluvium from intermediate igneous rocks, sandstone & shale	Loams, or sandy loams, bisequent	10YR, mottled	Interior Valleys	Hue, texture, parent material	Mapped as a series of TATAU family in West Sarawak
	Sebat	Alluvium from biotite granite	Fine sandy clay loam	10YR or yellower	Levee alluvium	Hue, abundant manganese and mica	Mapped as a series of SEDUAU family in West Sarawak, rare or absent in Central/North Sarawak
TERBAT	Terbat	Alluvium from basic to intermediate igneous rocks	Fine silts and coarse loams	10YR or yellower over 7.5YR	Incipient levees	Hue, parent material	Mapped only in West Sarawak, rare or absent in Central and North Sarawak

Table I.3 *RECENT ALLUVIAL SOILS: CLAYS*

Family	Series	Parent Material	Texture	Hue	Topography, Type Locality	Diagnostic Features	Correlation Status
SEDUAU	Seduau	Alluvium from non-calcareous sedimentary rocks	Clay	10YR or yellower in upper 50 cm	Levee alluvium	Hue, parent material	Mapped throughout Sarawak
	Malang			Redder than 10YR in upper 50 cm, mottled		Hue, parent material	
	Paku	Alluvium from calcareous sedimentary rocks	Clay	Redder than 10YR above 50 cm	Levee alluvium Bau Area	Hue, Fe-concretions pH (?)	Mapped only in West Sarawak as a series of SEDUAU family
	-			10YR or yellower in upper 50 cm	Levee alluvium, Sg. Karabangan area	Hue, pH (?)	Small area in Lambir-Subis area, no series established.
	Sekati	Alluvium from biotite granite	Clay	10YR or yellower, (+ mottled phase)	Levee alluvium, Lundu area	Hue, abundant Mn and Mica mottled phase has B2 (ir)	Mapped only in West Sarawak as a series of SEDUAU family
RAMUN	Entebar	Alluvium from red mudstone	Clay	Redder than 10YR in upper 50 cm	Levee, Sg. Dor, Simanggang road	Hue, parent material	Mapped as a series of RAMUN family in West Sarawak
	Ramun	Alluvium/ colluvium from basic to intermediate igneous rocks	Clay (+ gritty or gravelly phase)	Redder than 10YR in upper 50 cm	Alluvial flat, Tarat Station	Hue, parent material	Mapped as a series of RAMUN family in West Sarawak

GLEY SOILS

Origin	Texture	Acid-Sulphate Layer	Soil Family	Soil Series Differentiated by Groundwater Salinity, Micromhos/cm			Phases (Organic Surface Layer)	
				<500	500-4,000	>4,000	0-25 cm	25-50 cm
Alluvial	Sands	Absent throughout 125 cm	TATAU	Tatau	Telok	Nonok		As peaty phase e.g. Tta-p
		" "	PLAN	Plan	–	–		
		Present within 0-125 cm	BELAT	Meraan	Pandak	Belat		Blt-p
	Loam & Silts	Absent throughout 125 cm	PAKAN	Pakan	Piasau	Sirik		Pkn-p
		Present within 0-125 cm	PALOH	Nangka	Nagor	Paloh		Ngr-p
	Clays	Absent throughout 125 cm	BIJAT	Bijat	Pendam	Buntal		Bjt-p
				Mundai	–	–		Mnd-p
				Kakai	–	–	not differentiated	Kka-p
		Present within 0-125 cm	RAJANG	Punda	Rampangi	Rajang		Rjn-p
Residual, Colluvial, Old alluvial	Clays	Absent throughout 125 cm	SEMADO (Upland gley soils)	Semado	–	–		Smd-p
				Bokah	–	–		Bkh-p
				Embang	–	–		Emb-p
			DALAN	Ajoh Dalan	–	–		Dln-p
			JIWAN	Jiwan	–	–		Jwn-p
			PENARA	Penara	–	–		Pnr-p

Acid-sulphate depth phases

For those soils with acid-sulphate layer present within 0-125 cm, the depth at which acid-sulphate layer occurs is denoted as depth phase of the soil series as follows:

a1 - acid-sulphate layer within 0-50 cm from the surface

a2 - acid-sulphate layer within 50-75 cm from the surface

a3 - acid-sulphate layer within 75-125 cm from the surface

Where peaty phase also occurs, acid-sulphate depth is indicated as follows: e.g. Rjn-Pa1, Pnd-Pa2.

Table II.1 SALINE GLEY SOILS: SANDS AND LOAMY SANDS

Family	Series	Hue	Depth to acid sulphate layer	pH KCL	Conductivity micromhos/cm at 25^oC	Surface peat	Correlation Status
BELAT	Not differentiated	Grey or dark grey	Not defined	Less than 3.5 within 100 cm	Over 5,000	Absent	Mapped throughout Sarawak
NONOK	Not differentiated	Grey or dark grey	Not defined	3.5 or more throughout 100 cm	less than 5,000 but over 500	Absent	Mapped throughout Sarawak

Table II.2a ***SALINE GLEY SOILS:*** ***LOAMS AND SILTS***

Family	Series	Texture	Hue	Acid Sulphate horizon	Conductivity micromhos/cm at 25°C	Surface Peat	Diagnostic Features	Correlation Status
PALOH	Paloh	Fine silt	Grey or dark grey	within 25 cm from surface (?)	Over 5,000	Absent	Texture, conductivity level	Tentative families in Central Sarawak only
SIRIK	Sirik	Fine silt	Grey or dark grey	Not defined	Over 500, less than 5,000	Absent		

Table II.3 SALINE GLEY SOILS: CLAYS

Family	Series	Texture	Hue	Acid Sulphate horizon	Conductivity micromhos/cm at 25°C	Surface Peat	Diagnostic Features	Correlation Status
RAJANG	Rajang	Clay	Dark grey or greenish grey	Present within 25 cm	Over 5,000	Absent	Conductivity level	Mapped throughout Sarawak
PENDAM	Pendam	Clay	Grey, dark grey or greenish grey	All depth possible within 125 cm. see Table II.2b	Over 500 but less than 5,000	Absent	Conductivity level, no surface peat	
	Jol	Clay	Grey or dark grey			Present	Conductivity level, surface peat present	

Table II.2b *Depth Phase to Saline Horizon and Salinity Rating for SALINE GLEY SOILS*

Depth to Saline Horizon		Salinity Ratings of Soil (Moist)		Soil Group/Family
Electric conductivity exceeding 500 micromhos/cm at 25°C within	Depth Phase coding	Micromhos/cm at 25°C	Rating	
		Less than 500	-	GLEY SOILS
0 - 25 cm	1	501 - 1000	1	SALINE GLEY SOILS, example: PENDAM family
25 - 50 cm	2	1001 - 2000	2	
50 - 75 cm	3	2001 - 3000	3	
75 - 100 cm	4	3001 - 4000	4	
below - 100 cm	5	4001 - 5000	5	
		Over 5001	6	SALINE GLEY SOILS, example: RAJANG family

Notes:- 1. The depth of non-saline horizon to the saline horizon as given by the depth phase coding and the salinity rating follows immediately after the series coding.
Example:- Pnd. 3.2 means that in this Pendam series soil, the salinity of the control section exceeds 1,000 but is less than 2,000 micromhos/cm at 25°C below 50 cm from the surface.

2. Potential acid sulphate horizon (air dry soil which pH H_2O pf less than 3.5 and water soluble sulphur as sulphate exceeds 0.1%) could be included and shown.
Example:- Pnd. 3.2A means that the subsoil 50 cm below the surface is potentially acid sulphate.

Table III.1 GLEY SOILS: SANDS AND LOAMY SANDS

Family	Series	Parent Material	Texture	Topography, Type Locality	Hue	Surface Peat	Diagnostic Features	Correlation Status
TATAU	Tatau	Marine sand	Sands or loamy sands	Coastal swales	light grey or grey but not greenish grey below 50 cm	Absent	Parent Material, hue	As Tatau series of TATAU family
	Matu					Present	As Tatau series but with surface peat	Not mapped in West Sarawak
PLAN	Plan	Riverine sand	Sands or loamy sands	Interior valleys	light grey or grey but not greenish grey below 50 cm	Absent	Hue, parent material	Mapped as Plan series of TATAU family
	Luis					Present	As Plan series but surface peat present	Not mapped in West Sarawak

Table III.2 GLEY SOILS: LOAMS AND SILTS

Family	Series	Parent Material	Texture	Topography, Type Locality	Hue	Surface Peat	Diagnostic Features	Correlation Status
PAKAN	Pakan	Riverine alluvium or colluvium	Coarse loams	Alluvium or colluvium in interior valleys	Not greenish grey	Absent	Texture, surface peat absent	Mapped in Central and North Sarawak
	-					Present	Surface peat present	New series possible
	Gong	Old alluvium	Coarse loams	Old flood plain, 13th mile Serian Road and Lundu Area	Pallid not greenish grey	Absent	Texture, topography, parent material	Mapped as a series of TATAU family in West Sarawak only
	-	Riverine alluvium	Fine silts	Alluvium or colluvium in interior valleys	Not greenish grey	Absent	Texture, peat absent	New series possible
	-					Present	Texture, surface peat present	

Table III.3a **GLEY SOILS:** **CLAYS**

Family	Series	Parent Material	Texture	Topography, Type Locality	Hue	Surface Peat	Diagnostic Features	Correlation Status
	Bijat		Clay		Not GY or dark grey	Absent	Hue, parent material	Mapped throughout Sarawak
	Samarahan	Riverine alluvium,	Clay		Hue GY within 50 cm	Absent	Hue, parent material	Mapped as a series of BIJAT family in West Sarawak only
	Danau	noncalcareous	Clay or sandy clay	Riverine flood	~~Hue,~~ Dark grey within 50 cm		Hue, parent material, high C% (?)	Tentative series, Fifth Division, North Sarawak
BIJAT	Punda	Riverine alluvium over old marine clay	Clay	plain	Dark grey below 50 cm		Hue, acid sulphate horizon below 50 cm	Mapped as a series of BIJAT family in West Sarawak only
	Paya Megok	Riverine alluvium from limestone, shale, basic igneous rocks	Clay		Not GY or dark grey	Absent	High calcium, BS% and C%	Mapped as a series of BIJAT family in West Sarawak only
	Mundai	Riverine alluvium from calcareous rocks	Sandy clay	Limestone flats, limestone area, Kuching	Not GY or dark grey		High pH, calcium	Mapped as a series of TATAU family in West Sarawak only
	Kakai	Riverine alluvium from intermediate basic igneous rocks	Clay	Inland valleys	Dark grey but not GY below 50 cm		Mn and Fe concretions in B horizon	Mapped as a series of BIJAT family in West Sarawak only

Table III.3b *GLEY SOILS*: *CLAYS* (continued)

Family	Series	Parent Material	Texture	Topography, Type Locality	Hue	Surface Peat	Diagnostic Features	Correlation Status
BIJAT	Sebandi	Riverine alluvium, non-calcareous	Clay or sandy clay	Riverine flood plains and interior valleys	Not GY or dark grey	Present	Surface peat	Mapped throughout Sarawak
	Krain					Present	Bir(g), hard, below 50 cm, surface, peat present	Mapped as Krain series of BIJAT family in West Sarawak
	Kluang	Riverine and marine alluvium	Clay or sandy clay	Riverine flood plains	Grey or dark grey below 50 cm	Present	Acid sulphate horizon below 50 cm, surface peat	Mapped in West Sarawak as a series of BIJAT family
SEMADO	Semado	Residual - sedimentary	Clay or sandy clay	Long gentle slope, Mile 90-100th Simanggang Road	Pallid within 50 cm	Absent	Parent material, peat absent	Mapped as a families in West Sarawak
	Gerawat	Residual - sedimentary	Clay or sandy clay	Long gentle slope on highlands	Pallid within 50 cm	Present	Parent material, peat present	
	Bokah	Colluvial/ residual	Clay or sandy clay, stratified	Foot of long dip slopes, Bau-Lundu Area	Pallid, gleyed throughout	Absent	Parent material, texture, topography	Mapped as a series of TATAU family in West Sarawak
	Embang	Old alluvium	Clay or sandy clay	Undulating old coastal plain, upper Sadong	Pallid, gleyed throughout	Absent	Parent material, topography	Mapped as EMBANG family in West Sarawak

Table IV PODZOLS AND GROUNDWATER PODZOLS

Family	Series	Parent Material	Texture	Hue	Topography, Type Locality	Diagnostic Features	Correlation Status
MIRI	Miri	Old alluvium, quartzitic	Sand or loamy sand	Pallid A2 over very dark, firm B2h	Terraces	Parent material, hard spodic horizon	Mapped throughout Sarawak
	Bako	Sedimentary, sandstone	Sand sandy loam		Gentle dip slopes	Parent material, hard spodic horizon	Mapped as a family in West Sarawak
BUSO	Buso	Old alluvium, quartzitic	Sand or sandy loam	Pallid A2 or dark brown B2h	Terraces	Parent material, weak spodic horizon	Mapped as a family in West Sarawak
	Silantek	Sedimentary, sandstone	Sand or sandy loam	Pallid A2 over pale brown or dark brown B2h	Gentle dip slopes	Parent material, weak spodic horizon	Mapped as a family in West Sarawak
JERIJEH	Pueh	Marine sand	Sand or loamy sand	Pallid A, Bhir is 7.5YR or redder	Sub-recent beach	Parent material, Bhir horizon hue	Mapped as a series of JERIJEH family in West Sarawak only
	Stoh	Marine sand	Sand or loamy sand	Pallid A, Bhir is 10YR	Sub-recent beach		

Table V.1 GREY WHITE PODZOLICS: SAND AND LOAMY SAND

Family	Series	Parent Material	Texture	Hue	Topography, Type Locality	Diagnostic Features	Correlation Status
TIKA	Kilong	Alluvial	Sand/loamy sand	Pallid	Terraces, 1st and 4th Division	Parent material, topography	Mapped in West Sarawak as series of GAYA family
	Tika	Sedimentary			Undulating low hilly		Tentative series in Central Sarawak

Table V.2 GREY WHITE PODZOLICS: LOAM AND SILT

Family	Series	Parent Material	Texture	Hue	Topography, Type Locality	Diagnostic Features	Correlation Status
SARATOK	Saratok	Sedimentary, noncalcareous fine sandstone and sandy shale	Coarse loams	Pallid throughout	Low hilly, Central Sarawak	Texture, hue	Mapped throughout Sarawak
	Penipah			Variegated below 50 cm			Mapped in Central Sarawak only, 1973
	Durin		Fine loams	Pallid throughout			
BANDANG	Bandang		Fine silt	Pallid throughout			
	Timeng			Variegated below 50 cm			
TRIBOH	Triboh	Alluvium or colluvium	Texture contrast within 75 cm from the surface, upper subsoil coarse loam	Pallid	Colluvial, foot-slope, terraces	Parent material, texture	Mapped throughout Sarawak
	Kemunyang	Alluvium or colluvium over residual			Lower hill slopes		Mapped in Central Sarawak only, 1973
LUBAI	Lubai	Old alluvium	Texture contrast within 75 cm from the surface, upper subsoil fine silt		Low hilly	Parent material, texture	Mapped throughout Sarawak
	Merang	Chert or old alluvium			Low hilly		Mapped as a series of LUBAI family

Table V.3 GREY WHITE PODZOLICS: CLAYS

Family	Series	Parent Material	Texture	Hue	Topography, Type Locality	Diagnostic Features	Correlation Status
KERAIT	Kerait	Sedimentary, carbonaceous shale	Clay	Pallid throughout	Low hilly	Parent material, hue	Mapped throughout Sarawak
	Ajoh			Variegated below 50 cm			Established in Central Sarawak
	Rukum	Phyllite/chert		Pallid - bluish grey	Low undulating Lundu area		Mapped as a series in West Sarawak
	Serayan	Chert	Clay - coarse sandy	Pallid - pinkish			
	Lingga	Microgranite	Clay, silty	Pallid	Steep mountain slopes		Mapped as a series of SARATOK family in West Sarawak

Table VI.1 RED YELLOW PODZOLICS: SANDS AND LOAMY SANDS

Family	Series	Parent Material	Texture	Hue	Topography, Type Locality	Diagnostic Features	Correlation Status
PENINJAU	Peninjau	Sedimentary - sandstone	Sand or loamy sand	10YR or yellower	Hilly, Lambir 4th Division	Parent material, hue	Established in North Sarawak
	Sebaya	Colluvium and Alluvium			Colluvial fans	Parent material	Established in Central Sarawak

Table VI.2 *RED YELLOW PODZOLICS: LOAMS*

Family	Series	Parent Material	Texture	Hue	Topography, Type Locality	Diagnostic Features	Correlation Status
NYALAU	Nyalau	Sedimentary sandstone, noncalcareous	Coarse loams	10YR or yellower above 50 cm	Hilly	Parent material, texture, no albic horizon	Mapped throughout Sarawak
	Matang			10YR or yellower throughout control section	Hilly, 1st Division	Parent material, texture, weak albic horizon present	Mapped in West Sarawak as MATANG family
	Sabangang	Old alluvium		10YR or yellower	Low undulating	Parent material, texture	Mapped as a family throughout Sarawak before 1973
BEKENU	Bekenu	Sedimentary, sandy shale, noncalcareous	Fine loams	10YR or yellower above 50 cm	Low hilly	Parent material, texture, hue	Mapped as a series throughout Sarawak
	Sarakei	Sedimentary, sandy shale, noncalcareous		Redder than 10YR throughout control section			Established in Central Sarawak, 1973
	Biawak	Greywacke sandstone		10YR or yellower	Low undulating, Lundu District	Parent material, hue	Mapped as a series in West Sarawak
	Tukau	Old alluvium		10YR or yellower above 50 cm	Low undulating	Parent material, hue	Established as a series in North Sarawak, 1973

Table VI.3: RED YELLOW PODZOLICS: CLAYS

Family	Series	Parent Material	Texture	Topography, Type Locality	Hue	Diagnostic Features	Correlation Status
ABOK	Abok	Microgranodiorite	Clay	Hilly, Mile 78, Simanggang Road	10YR - yellow throughout or redder	Parent material, hue, crumbly structure	Mapped as a series in West Sarawak only
	Bayur	Schist	Sandy clay	Hilly, Balai Ringin 1st Division	10YR - brownish yellow throughout	Parent material, crumbly, friable, bauxite nodules	Mapped as a series in West Sarawak only, localised
	Gumbang	Hornfels, tonalite	Clay	Steep hilly, Bau District	10YR - light yellowish brown	Parent material, shallow depth	Mapped as a series in West Sarawak only
	Gading	Granite and granodiorite, (coarse textured)	Sandy clay, gritty	Dissected hilly, Lundu District	Redder than 10YR, mainly 5YR	Parent material, hue	Mapped as a series in West Sarawak only
	Jagoi	Granite, granodiarite (coarse grained) low iron content	Sandy clay	Dissected hilly, Ulu Strap, 2nd Division	Redder than 10YR, mainly 7.5YR	Parent material, hue, almost similar to Gading series	Mapped as a series in West Sarawak only
	Keladan	Silicified volcanics (tuffaceous)	Clay	Undulating, low hilly, 19th Mile, Serian Road	Redder than 10YR, mainly 5YR (red)	Parent material, hue, shallow depth	Mapped as a series in West Sarawak only, localised
	Serin	Arkose		Dissected hilly, 33rd Mile, Serian Road	10YR - brownish yellow	Parent material, hue,	Mapped as a series in West Sarawak only, widespread

Table VI.3b RED-YELLOW PODZOLICS: CLAYS

Family	Series	Parent Material	Texture	Topography, Type Locality	Hue	Diagnostic Features	Correlation Status
MERIT	Bedup	Carbonaceous shale, pyritic (Triassic)	Clay	Dissected, hilly, Bedup, Upper Sadong District	10YR or yellower overlying pallid horizon	Hue, quartz and concretions in lower subsoil	
	Semongol	Carbonaceous shale, pyritic (Cretaceous)	Clay (50-60%)	Strongly dissected, hilly, Kuching District	10YR or redder, grey mottles in subsoil	Hue, mottled subsoil	Mapped in West Sarawak, 1st Division
	Padawan	Carbonaceous shale, local limestone influence (Cretaceous)	Clay	Dissected, hilly, Padawan, Kuching District	Yellower than 10YR	Hue, Group III oxides less than 20%	
	Begunan	Red mudstone, (Tertiary)	Clay (light)	Strongly dissected, hilly, Simanggang District	Redder than 10YR, reddish brown	Hue, parent material	Mapped in West Sarawak, 2nd Division
	Stom	Purplish mudstone, (Tertiary)	Clay (light)	Undulating low hilly, Bau-Lundu area	10YR, variegated red and grey subsoil	Hue, parent material	Mapped in West Sarawak, 1st Division
	Melugu	Shale (Tertiary)	Clay	Dissected, hilly, Simanggang District	10YR throughout control section	Hue, Group III oxides over 20%	Mapped in West Sarawak, 2nd Div., possibly correlated with Merit series in Central-North Sarawak
	Rapak	Shale (Jurassic)	Clay (concretionary B2)	Undulating low hilly, Mile 85-95, Serian-Simanggang Road	Redder than 10YR within 50 cm, subsoil variegated	Hue, iron concretion stoneline in B horizon, Group III oxides over 20%	Mapped in West Sarawak, Kuching Rural District
	Stass	Shale, with limestone influence (Cretaceous)	Clay (50-60%)	Strongly dissected, hilly, Bau District	10YR or redder, pale yellow and red mottles in subsoil	Hue, Group III oxides less than 20%(?), high C.E.C.	Mapped in West Sarawak, 1st Division
MERIT	Merit	Shale noncalcareous	Clay	Hilly, Central-North Sarawak	10YR, in upper 50 cm, redder than 10YR below 50 cm	Hue, Group III oxides less than 20%	Mapped in Central-North Sarawak
	Jakar	Shale	Clay (non-concretionary B)	Hilly, Central-North Sarawak	Redder than 10YR within 50 cm, subsoil non-variegated	Hue, Group III oxides less than 20%	Mapped in Central-North Sarawak
	-	Shale	Clay	Hilly	10YR throughout	Hue, Group III oxides less than 20%	Similar to Melugu series except for Group III oxides, new series possible
	Lupar	Old slluvium	Clay	Undulating low hilly	10YR throughout mainly	Gravel/pebble stoneline below 50 cm	As Lupar series of MERIT family, mapped throughout Sarawak

Table VI.3c RED YELLOW PODZOLICS: CLAYS (continued)

Family	Series	Parent Material	Texture	Topography, Type Locality	Hue	Diagnostic Features	Correlation Status
Undifferentiated but probably ABOK family	Changgan	Granite, granodiorite	Fine loam	Hilly, mapped in Central Sarawak only	Redder than 10YR throughout control section	Parent material, hue, C.E.C./clay less than 16, BS% 10-35	Possibly correlated with Gading or Jagoi series in West Sarawak
	Arip	Acid igneous rocks, rhyolite	Silty clay		Redder than 10YR throughout control section	Parent material, hue, C.E.C./clay 20-40, BS% less than 10	Possibly correlated with Gading, Jagoi or Keladan series in West Sarawak
	Nyaroh	Acid igneous, rhyolite	Clay (50%)		10YR or yellower throughout control section	Parent material, hue, C.E.C./clay over 16	Not certain
	Piring	Acid igneous, or metamorphics, biotite hornfels	Clay (60%)		Redder than 10YR throughout control section	Parent material, hue, C.E.C./clay less than 16, BS% less than 10	Possibly correlated with Gumbang, Gading, Jagoi or Keladan series in West Sarawak

Table VII BROWN FOREST SOILS: CLAYS

Family	Series	Parent Material	Texture	Topography, Type Locality	Hue	Diagnostic Features	Correlation Status
KABULOH	Kabuloh	Shale, calcareous	Clay	Low hilly, Lambir-Subis Area 4th Division	2.5YR or yellower mainly, olive brown	Parent material, BS% exceeds 80, pH exceeds 6.0 within 50 cm	Mapped in North Sarawak only, rare or absent in Central/West Sarawak
	Karabangan		Clay		10YR, increases to 7.5YR or redder in B horizon	Parent material, hue, BS% 50-80, pH exceeds 6.0 in lower part of control section	Mapped in North Sarawak only
	Tangap		Clay		10YR, increases to 7.5YR or redder, subsoil variegated	Parent material, hue, BS% less than 30 and pH less than 6.0 within control section	Mapped in North Sarawak only

Table VIII LATERITIC SOILS

Family	Series	Parent Material	Texture	Hue	Topography, Type Locality	Diagnostic Features	Correlation Status
TARAT	Terat	Basic to intermediate igneous - Serian volcanics	Clay (over 60%)	Redder than 10YR - mainly 5YR (red)	Hilly to steep hilly, 1st Division	Hue, Kaolinite dominant in clays, weak blocky structure	Mapped in West Sarawak only, rare or absent in Central and North Sarawak
	Bukit Batu	Basalt	Clay (less than 60%)	Redder than 10YR, mainly 7.5YR	Hilly, 2nd Division	Hue, gibbsite dominant in clays, weak blocky structure	
	Kintayan	Porphoritic andesite	Clay	10YR throughout	Gently undulating, 17th Mile, Serian Road	Hue, parent material, strong blocky structure	
	Jebong	Gabbro	Clay	Redder than 10YR, mainly 7.5YR	Hilly, Lundu area, very localised	Hue, parent material, gibbsite dominant in clays, compact	
	Sejinkat	Silicified basic volcanics, Sejinkat Formation	Clay	Redder than 10YR, mainly 7.5YR	Steep hilly, Lower Sadong	Hue, parent material, strong blocky structure	

Table IX SKELETAL SOILS

Family	Series	Parent Material	Texture	Topography, Type Locality	Hue	Soil depth	Diagnostic Features	Correlation Status
MELUAN	Not differentiated	Igneous and sedimentary	All textures	Very steep hilly	10YR or redder	Less than 25 cm over lithic horizon	Soil depth	Mapped throughout Sarawak
SEDONG	Suka	Intermediate and basic igneous rocks	Clay loams and clay.	Steep hilly			Parent material, total P over 500 p.p.m	Mapped in West Sarawak only
KAPIT	Kapit	Sedimentary, noncalcareous rocks	Loams and clay	Hilly	10YR or redder	Less than 25 cm over weathered rocks	Parent material, total P less than 500 p.p.m	Mapped throughout Sarawak
	Buri	Acid igneous rocks	Clay.					Mapped as a series of KAPIT family in West Sarawak only
BINATANG	Binatang	Colluvium or alluvium over sedimentary rocks	Clay	Valley floors	10YR or yellower		Parent material, imperfect to moderately well drained	Mapped in Central and North Sarawak only
	Kelupu		Clay		Pallid		Parent material, poor to very poor drainage	
Gaya	Iundu	Colluvium from sandstone and granite	Sand and boulders, stratified	Colluvial fan - Lundu area	Pallid		Parent material, texture, hue	Mapped only in West Sarawak as Lundu series of GAYA families

Table X **PEAT SOILS**

<table>
<tr><th>Family</th><th>Series</th><th>Thickness of organic layer</th><th>Mineral horizon</th><th>Origin of organic layer</th><th>Loss on ignition %</th><th>Conductivity umhos/cm at 25°C</th><th>pH KCl</th><th>Correlation Status</th></tr>
<tr><td>IGAN</td><td>Not differentiated</td><td rowspan="6">25-100 cm</td><td>Sand</td><td rowspan="3">Residual</td><td>Not differentiated</td><td rowspan="2">Less than 500</td><td>3.5 or more</td><td>Mapped as a family throughout Sarawak</td></tr>
<tr><td rowspan="5">MUKAH</td><td>Mukah</td><td rowspan="3">Clay</td><td rowspan="3">Over 65</td><td>3.5 or more</td><td>Mapped throughout Sarawak</td></tr>
<tr><td>Patok</td><td rowspan="2">Over 500</td><td rowspan="2">Less than 3.5</td><td rowspan="2">Mapped in Central Sarawak, 1973</td></tr>
<tr><td>Lahat</td><td>Alluvial</td></tr>
<tr><td>Epai</td><td rowspan="2">Clay</td><td rowspan="2">Residual</td><td rowspan="2">Less than 65</td><td>Less than 500</td><td>3.5 or more</td><td rowspan="2">Mapped in North Sarawak, 1973</td></tr>
<tr><td>Merapok</td><td>Over 500</td><td>3.5 or more</td></tr>
<tr><td rowspan="4">ANDERSON</td><td>Anderson</td><td rowspan="4">Over 100 cm
<u>Depth phase are:</u>
Anderson 1: 100-200cm
Anderson 2: 200-300cm
Anderson 3: over 300cm</td><td>Not differentiated</td><td>Residual</td><td>Over 65</td><td>Less than 500</td><td>3.5 or more</td><td>Mapped through-out Sarawak</td></tr>
<tr><td>Gadong</td><td>Clay or sandy clay</td><td>Residual</td><td>Less than 65</td><td>Less than 500</td><td>3.5 or more</td><td>Mapped in North Sarawak, 1973</td></tr>
<tr><td>Limbang</td><td>Not differentiated</td><td>Alluvial/ residual</td><td>Not differentiated</td><td>Over 500</td><td>3.5 or more</td><td>Mapped throughout Sarawak</td></tr>
<tr><td>Luk</td><td>Not differentiated</td><td>Alluvial/ residual</td><td>Not differentiated</td><td>Over 500</td><td>Less than 3.5</td><td>Mapped in Central Sarawak only, 1973</td></tr>
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