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STRATIGRAPHIC TABLES, PAPUA NEW GUINEA

Compiled by

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DEPARTMENT OF NATIONAL DEVELOPMENT

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SUMMARY

The major stratigraphic units on the 1:1 000 000 map of Papua New Guinea published by BMR in 1972 are divided into their constituent units mapped at the 1:250 000 scale. Age, thickness, 1:250 000 Sheet area distribution, lithology, and additional data of each of the constituent units are tabulated for the nine regional subdivisions defined on the 1:1 000 000 map. Stratigraphies for most of the Sheet areas in Papua New Guinea have been finalized, but data for some of them are lacking or incomplete - especially in the southwest mainland; in one Sheet area on the Papuan peninsula; and on islands northwest of the Admiralty Islands and northwest and east of New Ireland - and for others are subject to revision.

INTRODUCTION

This compilation presents in tabular form all the currently available information on the stratigraphy of Papua New Guinea. Almost all the data were compiled from publications (or their drafts) of the Bureau of Mineral Resources (BMR): Explanatory Notes, which accompany the 1:250 000 geological maps; Reports; and Bulletins. The framework of the compilation follows that used in the 1:1 000 000 geological map of Papua New Guinea published in 1972, so the tables cannot be fully utilized without reference to that map.

Of the seventy 1:250 000 Sheet areas covering Papua New Guinea, at the time of writing about 50 (which incidentally cover most of the land surface) have been mapped, and maps of part or all of 24 of them are now published. Maps of most of the remaining Sheet areas have been compiled, and dyelines of them are available on request to BMR or the Geological Survey of Papua New Guinea.

Since the 1:1 000 000 map was compiled in 1971 more mapping has been completed, and understandably there are some discrepancies between that map and the more-recently compiled 1:250 000 Sheets.

The stratigraphic tables below describe in some detail the composition of the generalized units into which the strata have been subdivided on the 1:1 000 000 map. These units are here referred to as major units so as to distinguish them from the specific map units of the individual 1:250 000 Sheets.

The tables are divided into nine sets, each set representing one of the nine regions into which the country was originally divided for the purpose of the presentation of its geology. The boundaries of these regions are shown on an inset map at the right-hand bottom corner of the 1:1 000 000 map (see also Fig. 1).

Tables for each region are subdivided into six vertical columns which describe each major unit in turn under the headings of 'Age', '1M map unit', 'Constituent unit(s) in 1:250 000 Sheet areas', 'Thickress', 'Lithology', and 'Additional pertinent data'.

Under 'Age' are listed ages assigned to individual major units in the Reference of the 1:1 000 000 map.

In the second column, under '1M map unit', are listed, in reverse chronological order (youngest at the top), the successive major stratigraphic units for the particular region of the 1:1 000 000 map.

The third column lists - by name and map symbol, or, where no name has been assigned, by map symbol only, or by a brief description and a symbol - units mapped in 1:250 000 Sheet areas or other large-scale map areas which have been incorporated into the major units. Many of the names listed are informal and should not, at least for a time, be used outside this compilation; the status of each name is shown in Index 1. Where known, the age ranges* of the stratigraphic units are also quoted. Units which, whether because of incompatible lithology, or age, or environment in which they formed, do not fit in a major unit but are not differentiated from it on the 1:1 000 000 map because of their small size are adequately referred to below the description of each major unit.

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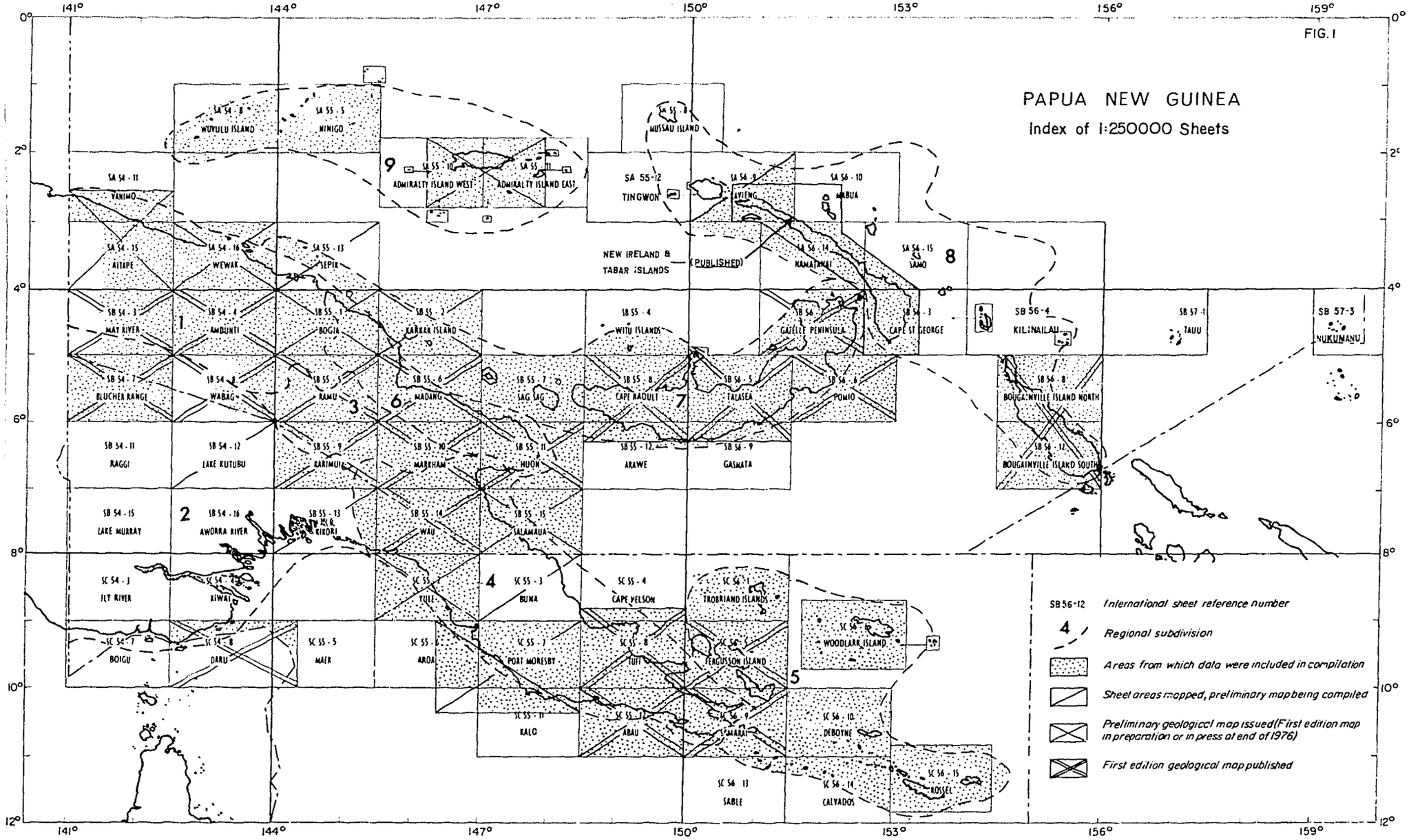
*The abbreviations 'e' (early) and 'l' (late) have been used for the finer age subdivisions of stratigraphic units in the stratigraphic tables.

FIG. 1

PAPUA NEW GUINEA

Index of 1:250000 Sheets



Known thicknesses are quoted in metres in the fourth column. Where available, the maximum, minimum, and average thicknesses are given, as are directions of thickening or thinning; approximate or estimated values are denoted by 'c'.

For the sake of brevity, the colour of a rock, which must be of doubtful value because of the absence of a standard colour chart, is omitted from the description of lithology in column five.

Detailed chemical analyses of constituent units are also omitted for the sake of brevity, but, where they are included in the explanatory notes on a 1:250 000 Sheet area, their existence is indicated by an asterisk at the end of the lithological description of the constituent unit. The generalized distribution of a given unit, as well as the variation in its lithology from one Sheet area to another where known, is clearly marked, but once again for the sake of brevity, both in the 'Lithology' and 'Additional pertinent data' columns, the words 'Sheet' or 'Sheet area' have been omitted; thus 'In the Madang 1:250 000 Sheet area.....' has been abbreviated to 'In Madang.....'.

The sixth and last column lists all the pertinent data additional to those already given in the preceding columns. These, where available, are: environment of formation, genetic and/or stratigraphic relations, fossil dating media, fossil content, age (when age closer than that of a stage is known), absolute age and method used, mineralization, and economic content or potential. For greater brevity, names of stratigraphic units have been shortened, where practicable, according to the system of abbreviation commonly used by BMR - a system which follows closely that of the Shell Petroleum Company. A key to the abbreviations used in the last column is in Appendix 1.

Gaps in the information in the tables are partly shown on the accompanying map (Fig. 1). Some Sheet areas are not represented at all, whilst data from others are subject to revision:

Region 1: Sheet areas and parts of Sheet areas not represented are Sepik, western May River, and western Wabag, all of which, however, have been fairly recently mapped; data from Vanimo, Aitape, and Wewak were compiled recently and are thus subject to revision.

Region 2: Sheet areas not represented are Boigu, Fly River, Kiwai, Lake Murray, Aworra River, Kikori, Raggi, Lake Kutubu, and part of Wabag. Of these, only Lake Kutubu and Kikori were recently mapped, and much of the rest of the area is covered by flat-lying Quaternary sediments.

Region 4: Buna Sheet area is not represented; information from Salamaua Sheet area is subject to revision.

Region 6: Data from the recently mapped Bogia Sheet area are subject to revision.

Region 8: Mussau and islands northeast of New Ireland are not represented.

SEPIK-RAMU REGION (1)

Age	1M map unit	Constituent unit(s) in 1:250 000 Sheet areas	Thickness (m)	Lithology	Additional pertinent data
Quaternary	Qa[1]	Qa Pleistocene-Holocene (At least partly included in Qs[1], Tmu[1], Jt[1])		AITAPE, BOGIA, VANIMO, WEWAK: Alluvium: gravel, sand, silt, mud MAY RIVER, AMBUNTI: also peat, tuffaceous sand	Locally disconf on Neumayer Beds and Wosera Beds; unconf on all older fms; grades later into Qm and Qc; includes some Qm, Qs. Source of gv
		Qm, Qha Pleistocene-Holocene	to 50 in Wewak; to 10 in Vanimo and Aitape	AITAPE, VANIMO, WEWAK, RAMU: Beach sand: lithic and calcareous sand, silt; minor gravel, beach rock	Grades later into Qa inland; unconf on Bliri Volc in Aitape, on Qc and Wirui Lst at Wewak, and on Serra Hills Lst in Vanimo. Source of building sand; provides well drained stable land for village and airstrip constr
		Qr Quaternary		SE AMBUNTI: Raised alluvial deposits of fine alluvium and sandy sediments	Uplifted 9 m, possibly by recent movement on Jimi Fault
		Qs Pleistocene-Holocene		VANIMO: Colluvium: chaotic deposits of angular to rounded rock fragments	Intramontane valley fill and areas of closed drainage in karst terrain
		Qc Pleistocene-Holocene (At least partly included in Qs[1])	to 50 in Wewak	VANIMO, WEWAK: Raised reef: coralgal reef limestone, biosparite, foraminiferal limestone, sand	Low part probably equiv of Wirui Lst, grades later into large terraces of Neumayer Beds; up part grades later into Qa; unconf on Puwani Lst, Bliri Volc; probably unconf on Serra Hills Lst. Age from larger benth foram and physical properties. Source of road metal; provides stable, well drained land for constr; potential source of lime
		Wirui Limestone (Qpr) Pleistocene-Holocene (At least partly in Tmu[1], KuTe[1])	to 100	WEWAK: Coralgal reef limestone, algal-foraminiferal biosparite; minor marl, calcareous foraminiferal siltstone, tufa	Equiv? to up part of Serra Hills Lst and low part of Qc in Vanimo; later? equiv of Wosera Beds, and possibly Ulahau Fgl; corr? of Wandokai Lst in Bogia and Madang, and older coral terraces in NE Huon; disconf and unconf? on Wewak Beds, Maprik Mdst; unconf on Torricelli Intr Comp, Bliri Volc. Age from

Qa^1 (contd)				larger foram; calc tufa locally contains leaf impressions. Quarried for road constr material; suitable as foundation material; good aquifer, but subjected to salt-water encroachment near coast at times of drought

Units not differentiated, at least in part, from Qa^1 on 1:1 000 000 map: In Aitape: Pleist Neumayer Beds and Wosera Beds, and Plio-Pleist Wuro Beds (see Qs^1); 1 Plio-Pleist Serra Hills Lst, 1 Plio? Romi Fm, and Plio Rofula Mem (see Tp^1); 1 Mio-e Plio Barida Beds (see Tmu^1); and 1 Eo Dimaie Volc, and L Cret-Eo Ambunti Metam (see $KuTe^1$). In Vanimo: 1 Plio-Pleist Serra Hills Lst and 1 Plio? Romi Fm (see Tp^1); e-1 Mio Senu Beds and 1 Mio-e Plio Barida Beds (see Tmu^1); and e-m Mio Puwani Lst (see Tmm^1). In Wewak: Plio-Pleist Wuro Beds (see Qs^1); 1 Plio? Romi Fm (see Tp^1); and 1 Mio-e Plio Barida Beds (see Tmu^1).

Qs^1	Qf, Qr, Qp Quaternary		BOGIA, RAMU: Poorly consolidated sandstone, siltstone, mudstone, raised alluvium; clastic boulder deposits, poorly sorted gravel, sand, silt, clay	
Quaternary	Wosera Beds (Qpw) Pleistocene (At least partly included in Qa^1)		AITAPE, WEWAK: Carbonaceous and ferruginous gravel, ironstained micaceous sand, sandy clay, peat, ironstone concretions; some laterite	Non-marine, fluv, low-angle alluv fans dep by ancestors of present major rivers. In Aitape, non-conf on Wuro Beds; unconf on Sibi Sst Mem, Nopan Sst, and older fms. In Wewak, probably contemp with Neumayer Beds to N; non-conf on Wuro Beds, Maprik Mdst. Age from degree of dissection and superpos. Source of gv for road constr; suitable for village sites and road alignments.
	Neumayer Beds (Qpn) Pleistocene (At least partly included in Qa^1, Tmu^1)	30-120? in Vanimo; to 30 in Wewak	AITAPE, VANIMO, WEWAK: Poorly consolidated gravel, sand, silt	Estuarine and non-marine fluv dep; unconf on Bulimp Fm, Romi Fm, Bewani Fm, Barida Beds, Senu Beds, Wewak Beds, Torricelli Intr Comp; probably contemp with Wosera Beds. Some horizons with marine and estuarine molluscs; human skull frag in one place. Age from superpos and degree of dissection. Source of gv; well drained - suitable for village sites and airstrip constr

Qs^1 (contd)	Ulahau Fanglomerate (TQu) Pliocene?-Pleistocene? (At least partly included in Tmm^1, Tml)	150?+	WEWAK: Fanglomerate: unsorted angular to rounded cobbles in unsorted, kaolinized, arkosic lithic sandstone matrix	Originated in non-marine fluv, and subaerial intramontane envir. Unconf on Prince Alexander Comp, Amogu Cgl, and Sargum Cgl in type area; possibly locally unconf on Mount Turu Comp; locally unconf on Wewak Beds. Age from superpos and equiv with Wirui Lst. Abd plant hash at some horizons. Where tested contains little or no Au
Quaternary	Wuro Beds (TQw) Pliocene-Pleistocene (At least partly included in Qa^1)	800-900 in Aitape; probably to 200 in Wewak	AITAPE, WEWAK: Poorly consolidated lithic sandstone, carbonaceous siltstone, mudstone	Dep in estuarine, intertidal, and non-marine envir during final regressive phase in Lumi Trough. In Aitape, non-conf overlain by Wosera Beds; conf on Sibi Sst Mem, Nopan Sst; overlaps unconf on Senu Beds locally; age from plank foram and superpos; minor lignite seams; some root struc, leaf imprints, carb logs. In Wewak, probably entirely marine where grades into Maprik Mdst; unconf on Prince Alexander Comp, Amogu Cgl, Sargum Cgl, Wewak Beds; appears to infill former valleys in Wewak Beds and Prince Alexander Comp; age from superpos and equiv? with Wirui Lst; where tested contains little or no Au
	Nopan Sandstone (TQn) 1 Pliocene-Pleistocene (At least partly included in Tml)	to 1970 in Aitape; probably less than 500 in Wewak	AITAPE: Alternating lithic sandstone and siltstone; poorly consolidated fine to coarse silty lithic sandstone with conglomeratic horizons and minor calcareous cemented beds, laminated carbonaceous siltstone, and sandy siltstone; sporadic large concretionery nodules WEWAK: Poorly consolidated fine sandstone, siltstone, mudstone; partly micaceous, carbonaceous, or bioturbated; partly calcareous with shelly horizons	Probably dep in shallow marginal marine envir with access to open ocean; locally in intertidal and fluv envir; becomes completely marine where grades into Maprik Mdst. Conf below Wuro Beds; conf on Maprik Mdst. In Aitape unconf below Wosera Beds; conf on Nanu Fm, Gwenif Fm in E; non-conf on Gwenif Fm, Lumi Fm, Senu Beds in centre and W; disconf and unconf on Fuk Beds. Contains shelly horizons in Wewak. Dated by foram (1 N20-21). Thin lignite seams present

Qs^1 (contd)	Sibi Sandstone Member (of Nopan Sandstone) (TQns) 1 Pliocene?-Pleistocene	400 at type section	AITAPE: Alternating silty, very carbonaceous, in places pebbly, lithic sandstone and laminated sandy siltstone	Possibly non-marine fluv dep; high concentrations of lignite indicate a strong terr influence. Conf on Nopan Sst, and either thins or grades into Nopan Sst later; conf below Wuro Beds; unconf below Wosera Beds. Age from superpos

Units not differentiated, at least in part, from Qs^1 on 1:1 000 000 map: In Vanimo: Pleist-Holo Qc (see Qa^1); and 1 Plio-Pleist Serra Hills Lst and Bulimp Fm, 1 Plio? Romi Fm, and Plio Bewani Fm (see Tp^1). In Aitape: Pleist-Holo Qa (see Qa^1); 1 Plio-Pleist Serra Hills Lst, 1 Plio Maprik Mdst, 1 Plio? Romi Fm, Plio Bewani Fm, Neni Fm, Rofula Mem, Tumoflu Mdst Mem, Nengare Mem, Fuk Beds, and Gwenif Fm (see Tp^1). In Wewak: Pleist-Holo Qa (see Qa^1); and Plio-Pleist? Maprik Mdst, Plio Wewak Beds, and 1 Plio? Romi Fm (see Tp^1).

Tp^1	Serra Hills Limestone (TQl) 1 Pliocene-Pleistocene (At least partly included in Qa^1, Qs^1, Tmu^1)	240 in Vanimo; to 180 in Aitape	AITAPE, VANIMO: Coral-reef limestone, biosparite, biomicritic chalk; marl; minor sandstone, siltstone at base	Dep in deep-water marine basin in S, which graded into shallow water; coral-reef platform at one place. Conf on Romi Fm; low part equiv of Romi Fm and possibly Bulimp Fm; unconf on Barida Beds, Senu Beds, Puwani Lst, Bliri Volc, Torricelli Intr Comp. In Aitape dated as 1 N20-21 to Pleist by plank foram
Pliocene	Bulimp Formation (TQb) 1 Pliocene?-Pleistocene? (At least partly included in Qs^1, Tmu^1)	to 1600	VANIMO: Well rounded to subrounded pebble conglomerate; minor siltstone and mudstone	Includes non-marine piedmont dep, and shows signs of marine incursion. Locally conf on Serra Hills Lst
	Romi Formation (Tpr) 1 Pliocene? (At least partly included in Qa^1, Qs^1, Tmu^1)	0-700; probably 200 in Wewak	VANIMO, AITAPE, WEWAK: Foraminiferal mudstone, marl, thin limestone, siltstone with coquinal lenses, shelly sandstone; some conglomerate and coarse lithic sandstone towards top. In Aitape also minor thin limestone beds; some carbonaceous material in upper part	Dep in central neritic fine-clastic basin with coarse-clastic marginal lithofacies, and limited to N by deeper-water and shallower-water reef carbonates. Conf on Bewani Fm?, and also on Neni Fm, Rofula Mem in Aitape; up part grades later to N into, and low part conf under, Bulimp Fm and Serra Hills Lst. In Aitape, non-conf on Barida Beds in E; later equiv of Krisi Fm and probably some Bulimp Fm,

Tp^1 (contd)				Serra Hills Lst; non-conf on Barida Beds, Puwani Lst, Bliri Volc in Vanimo; dated by abd plank foram; molluscs and abd larger benth foram also present
Pliocene	Krisi Formation (Tpks) 1 Pliocene?	600-1100	AITAPE, VANIMO: Poorly consolidated, fine to coarse, massive to thickly bedded, silty lithic sandstone; minor hard mudstone interbeds; calcareous cemented gritty horizons and thin coal seams; alternating sandstone and fossiliferous mudstone at top and bottom	Conf on Bewani Fm and under Bulimp Fm; unconf under Qa, Qs; W marginal marine lithofacies of low part of Romi Fm. Age from superpos
			NW WEWAK: Poorly consolidated, fine to coarse, massive to thickly bedded, silty lithic sandstone; minor hard mudstone interbeds; calcareous cemented gritty horizons and thin coal seams; alternating sandstone and fossiliferous mudstone at top and bottom	W, marginal marine lithofacies of low part of Romi Fm on strat and contained struc; conf on Bewani Fm; conf under Bulimp Fm; unconf under Qa, Qs; age from superpos; foss wood common
	Bewani Formation (Tpx) Pliocene (At least partly included in Qs^1, Tmu^1)	to 2500	AITAPE, VANIMO: Poorly consolidated micaceous mudstone and siltstone; some silty lithic sandstone and conglomerate	Dep in moderately deep water (outer neritic?), at least partly by t.c. Unconf below Neumayer Beds, and conf below Krisi Fm and Romi Fm; conf or disconf on Barida Beds; occupies same strat position as, and probably grades later into, Neni Fm in Aitape. Dated by plank foram (N19-21)
	Wewak Beds (Tpw) Pliocene (At least partly included in Qs^1, Tml, $KuTe^1$)		WEWAK: Poorly consolidated calcareous siltstone, sandy and pebbly siltstone, fine to coarse silty lithic sandstone, polymictic and sandy conglomerate; bioturbation	Shallow-marine and perhaps fluv sed dep in shallow and deep water by t.c. Unconf below Neumayer Beds, Wirui Lst, locally Ulahau Fgl; non-conf below Wewak Beds; unconf on Marabu Lst, Sargum Cgl; non-conf on Senu Beds, Tmg; unconf on Bliri Volc, Torricelli Intr Comp, Mount Turu

Tp^1 (contd)				Comp. Dated by plank foram (N18-21); contains shelly lenses and bioturbation strucs. Where tested contains little Au; probable source of oil seeps in places
	Neni Formation (Tpne) Pliocene (At least partly included in Qs^1, Jt^1?)	to 2300	AITAPE: Alternating mudstone and sandstone with calcareous concretions and carbonaceous laminae at bottom; fissile mudstone with pyritic clay laminae and occasional sandstone beds in middle; and sandy upper part with alternating mudstone, siltstone and sandstone, thick sandstone, conglomerate, and pebbly mudstone, becoming more conglomeratic and shelly towards top	Shallow to deeper marine. Conf below Romi Fm; conf or disconf on Barida Beds, clasts of which occur in low Neni Fm; non-conf on Senu Beds, and unconf on Bliri Volc locally; strat equiv and probably later lithofacies of Bewani Fm. Dated by plank foram
Pliocene	Rofula Member (of Neni Formation) (Tpnr) Pliocene (At least partly included in Qa^1, Qs^1, Jt^1)	700-1350	AITAPE: Poorly consolidated, thinly interbedded mudstone, siltstone, and fine lithic sandstone; thinly and irregularly interbedded sandy subangular to rounded polymictic conglomerate, lithic sandstone, and sandy siltstone: minor reef-knoll limestone; calcite-cemented concretions	Conf on Tumoflu Mdst Mem; conf below Romi Fm; unconf below Neumayer Beds; includes some Nengare Mem in S; includes some Tumoflu Mdst Mem locally. Molluscs, waterworm plant debris
	Tumoflu Mudstone Member (of Neni Formation) (Tpnt) Pliocene (At least partly included in Qs^1)	365	AITAPE: Poorly consolidated, regularly laminated fissile micaceous mudstone with pyritic clay partings; occasional sandstone beds with large lenticular concretions	Conf below Rofula Mem, and conf on Nengare Mem; probably E tongue of Bewani Fm; locally disconf overstepped by Rofula Mem; rests directly on Nengare Mem
	Nengare Member (of Neni Formation) (Tpnn) (At least partly included in Qs^1)	to 610	AITAPE: Dominantly argillaceous; poorly consolidated, thinly and irregularly interbedded mudstone and sandstone; occasional thicker mudstone beds; minor thin fine conglomerate near base	Conf below Tumoflu Mdst Mem; conf and grad or disconf on Barida Beds; in places disconf below Rofula Mem; probably locally disconf overstepped by Rofula Mem and Romi Fm

Tp^1 (contd)	Maprik Mudstone (Tpp) 1 Pliocene (in Aitape) Pliocene-Pleistocene? (in Wewak) (At least partly included in Qs^1, Tmu^1, Tml)		AITAPE, WEWAK: Poorly consolidated foraminiferal mudstone and siltstone, cross-bedded or laminated fine micaceous silty sandstone; minor concretionary limestone and sandstone	Probably marginal marine envir, possibly partly intertidal in W; becomes deep-water marine in E. Conf on Nanu Fm, into which grades to W; conf below Nopan Sst. Dated by plank foram (N19-21)
			WEWAK: Also some clay-pebble or polymictic conglomerate, shelly mudstone	Locally represents basinward fine clastic lithofacies equiv successfully to Nanu Fm, Ipe Fm, Misa Fm, and in places Sargum Cgl. Conf on, and probably grades later into, Sargum Cgl, Misa Fm, Ipe Fm, Nanu Fm; disconf? on Nanu Fm in W; conf on Mount Turu Comp, Torricelli Intr Comp, Senu Beds in E; conf below and grades later into Nopan Sst, Wuro Beds. Dated by plank foram (N18?, N19-21, N22?); contains leaf imprints in places
Pliocene	Nanu Formation (Tpu) Pliocene	c.60 in E, to 1200+ in W in Wewak	AITAPE, WEWAK: Poorly consolidated, medium to fine silty sandstone, with large platy calcareous concretions; interbeds of siltstone and mudstone; sandstone partly lignitic, pebbly or cross-bedded	Probably dep in high-energy shallow-marine envir. In Aitape, probably shales out to W into Gwenif Fm, and up part grades later to E into Maprik Mdst locally; probably conf below Maprik Mdst; conf below Nopan Sst; conf on Ipe Fm, Kumal Marl Mem, Lumi Fm; dated by plank foram (1 N19-21). In Wewak, basal beds appear to interf to W with up Ipe Fm
	Ipe Formation (Tpi) e Pliocene (At least partly included in Tmu^1)	800 in Wewak; 600+ in Aitape	AITAPE, WEWAK: Poorly consolidated, bedded, and massive calcareous mudstone and siltstone; mottled calcareous siltstone and hard marl, locally pebbly with small concretions; silty lithic sandstone and pebbly sandstone	Probably dep in quiet neritic envir. In Wewak, probably grades later into Maprik Mdst to E; low part possibly grades later into Boini Beds to W; conf on Misa Fm; conf below Nanu Fm, Maprik Mdst; locally uppermost beds appear to interf with basal Nanu Fm to E; some horizons rich in small molluscs or carb material. In Aitape, age from foram (N19) and superpos

Tp[1] (contd)	Kumal Marl Member (of Ipe Formation) (Tpik) (At least partly included in Tmu[1])	230 in type section in Aitape; probably thins to W	AITAPE, WEWAK: Marl, marly, and in places concretionary fine sandstone, and calcareous sandy siltstone, all with small irregular concretions; minor interbedded conglomerate and coarse, in places pebbly, lithic sandstone at base	In Aitape, conf below Nanu Fm; conf and trans on Mai Cgl Mem; abd shelly horizons and plank foram (N19). In Wewak, may grade later into undiff Ipe Fm to E; conf below Nanu Fm
	Mai Conglomerate Member (of Ipe Formation) (Tpim) e Pliocene	250 in type section	AITAPE: Hard massive to thickly bedded polymictic conglomerate, and coarse to very coarse pebbly lithic sandstone; minor marly fine sandstone with scattered small irregular concretions	Probably grades to E into undiff Ipe Fm, Boini Beds in places with short trans sequence. Conf below and trans into Kumal Marl Mem
	Boini Beds (Tpb) e Pliocene (At least in part included in Tml[1])		AITAPE, WEWAK: Poorly consolidated, thinly interbedded, carbonaceous and micaceous laminated sandy siltstone, fine sandstone, and slightly calcareous, partly bioturbated siltstone; minor coarse lithic sandstone and sandy conglomerate	In part dep by t.c. Conf below Mai Cgl Mem; conf? or disconf? below Lumi Fm and on Senu Beds; locally conf? on Songaien Fm; grades later to E into Misa Fm and Ipe Fm. Age from plank foram (1 N18-19) and superpos
Pliocene	Misa Formation (Tpm) e Pliocene (At least partly included in Tmu[1], Tml[1])	900 in type section in Wewak	AITAPE, WEWAK: Poorly consolidated medium to coarse silty sandstone with scattered concretions; pebbly sandstone; fine polymictic conglomerate with lenses of sandy conglomerate; micaceous sandy siltstone and pebbly siltstone; minor impure limestone in places	Probably dep in high-energy shallow-marine envir. Conf on Songaien Fm in W and Sargum Cgl in E; disconf? on Puwani Lst locally;conf below Ipe Fm; grades later to W into low part of Boini Beds; grades to E from top down into Maprik Mdst. Dated by plank foram; abd coral frag in minor impure lst
	Songaien Formation (Tps) e Pliocene (At least partly included in Tmu[1], Tml[1])	460 in type section	AITAPE, WEWAK: Poorly consolidated massive partly micaceous foraminiferal siltstone and mudstone; subordinate interbedded siltstone and fine silty sandstone towards base; minor pebbly siltstone with slump structures, and in places graded coarse pebbly lithic	Dep in moderately deep water (outer neritic?), partly by t.c. Conf on Molang Creek Fm, conf below Misa Fm, and possibly below Boini Beds in Aitape; locally non-conf on Senu Beds. Dated by plank foram (1 N18-19)

	Tp^i (contd)		sandstone with shale clasts; quartz common in pebbly horizons, or minor pebbly siltstone	
	Molang Creek Formation (Tpo) e Pliocene (At least partly included in Tmu^1, Tml^1)	200-2000 in Wewak	AITAPE, WEWAK: Hard calcareous siltstone and mudstone; pebbly siltstone with quartz clasts; poorly consolidated interbedded carbonaceous fine silty sandstone and sandy siltstone; subordinate conglomerate and sandy conglomerate	Dep in deep water in part by t.c. In Wewak, conf? or disconf on Senu Beds, and conf below and trans into Songaien Fm. Age from plank foram (1 N18-19)
	Sargum Conglomerate (Tpc) e Pliocene (At least partly included in Tmu^1, $KuTe^1$)		WEWAK: Poorly consolidated, massive to irregularly bedded, subangular to subrounded, granule to cobble polymictic conglomerate, sandy conglomerate, and pebbly medium to very coarse silty lithic sandstone; some micaceous, carbonaceous, and calcareous siltstone, sandy siltstone, and pebbly siltstone	Possibly accumulated by dumping of well rounded, shallow marine or fluv gv in deep water by t.c. and gravity sliding. Conf? or disconf on Torricelli Intr Comp, Prince Alexander Comp, Mount Turu Comp, and Ambunti Metam; conf below and probably later equiv of low Misa Fm, Wewak Beds, and some Maprik Mdst; unconf below Ulahau Fgl. Dated by plank foram; includes some undiff l Mio or e Plio (N18-19), but probably all Plio. Important source of alluv Au where basal on Prince Alexander Comp and Mount Turu Comp
Pliocene	Fuk Beds (Tpf) Pliocene (At least partly included in Qs^1)	470+	AITAPE: Poorly consolidated, massive, shelly siltstone, thinly bedded mudstone; some sandstone, minor limestone	Disconf or unconf under Nopan Sst; unconf under Qs; disconf? or unconf on Senu Beds; faulted against Senu Beds and basement units. Dated by plank and larger benth foram (N19-21); includes N19, 1 N17-21?, N16-19 and Plio to Recent farther W
	Tp Pliocene	probably to 100 in N	AITAPE: Poorly consolidated interbedded calcareous mudstone and micaceous siltstone, with subordinate thin sandstone and minor lignitic streaks; some conglomerate	Unconf on Senu Beds, Puwani Lst, Tom, Ambunti Metam. Locally grades later into, and possibly represents deep-water, offshore lithofacies of part of Border Mtns Lst Beds. Dated by plank foram (N18-20)

Tp^1 (contd)	Border Mountains Limestone Beds (Tzl) Miocene? or Pliocene?	300?	AITAPE: Massive reef-coral limestone; nodular bedded biopelsparite; some silty coralline biomicrite	Unconf on Ambunti Metam, Amanab Metadr, and probably P; in E, possibly grades later into Tp as deep-water, offshore lithofacies; may be corr of Puwani Lst
	Gwenif Formation (Tpg) Pliocene (At least partly included in Qs^1, Tmu^1)	1500 in type section	AITAPE: Poorly consolidated thinly to thickly bedded micaceous sandy siltstone and shelly silty mudstone; minor fine to medium calcareous silty sandstone with occasional thin pebbly horizons; sandstone more common towards base	Probably dep in low-energy shallow-marine envir. Conf on Lumi Fm through short trans sequence; in E, disconf below Nopan Sst, which unconf oversteps it onto Lumi Fm and Senu Beds to W; probably grades later into Neni Fm locally. Dated by plank foram (N19-21)
Pliocene	Lumi Formation (Tpl) Pliocene (At least partly included in Tmu^1)	160-1030	AITAPE: Poorly consolidated, bedded or massive, angular to subrounded, granule to cobble polymictic conglomerate, sandy conglomerate, and conglomeratic lithic sandstone; sandy siltstone, partly laminated, micaceous, carbonaceous, or pebbly; siltstone; medium to fine silty sandstone; minor carbonaceous mudstone with thin lignitic seams	Shallow-marine envir, probably partly fluv in W. Conf below Gwenif Fm; conf or disconf on Boini Beds; probably disconf, locally unconf?, on Senu Beds; unconf on Ambunti Metam locally; nonconf below Nopan Sst, which oversteps it locally onto Senu Beds. Dated by plank foram (N19-21)
	Marabu Limestone (Tpz) e Pliocene? (At least partly included in Tmu^1)	to 90	WEWAK: Well bedded and massive, slightly silty biosparite and biopelsparite	Dep on shallow-marine carbonate shelf with strong open-sea influence. Conf below Wewak Beds; conf? or disconf on Senu Beds, Tmsg. Mio or younger on foram only; strat and lithologic evidence point to e? Plio; abd plank and larger foram, and coral, algal, mollusc, and echino debris

Units not differentiated, at least in part, from Tp^1 on 1:1 000 000 map: In Aitape: l Mio-e Plio Barida Beds and e-l Mio Senu Beds (see Tmu^1); and l Oligo? Tom (see To^1). In Vanimo: l Mio-e Plio Barida Beds (see Tmu^1); and e-m Mio Puwani Lst (see Tmm^1). In Wewak: l Mio-e Plio Barida Beds (see Tmu^1)

Tmu[1]	Barida Beds (Tmpb) l Miocene-e Pliocene (Partly included in Qa[1], Tp[1], Tml)	to 1220? in Wewak and Aitape; 200-600 in Vanimo	AITAPE, WEWAK, VANIMO: Hard massive limestone, in places silty; compact massive marl; compact massive limestone and marl conglomerate; subordinate interbedded silty lithic or calcareous sandstone or siltstone and in places foraminiferal siltstone; minor coralline limestone in places	Dep in deep water with little terr influence. Probably conf and trans on Senu Beds; conf? on Puwani Lst in W; probably conf below Bewani Fm in W and Neni Fm in E; non-conf below Romi Fm in places; unconf below Neumayer Beds and Serra Hills Lst, and unconf on Bliri Volc. Dated by abd plank foram (probably l N16-19) and deep-water smaller benth foram; shallow-water molluscs also present
	Senu Beds (Tms) e-l Miocene (At least partly included in Qa[1], Tp[1], Tmm[1], Tml[1], Tml, KuTe[1], Jt[1])	to 2700 in Aitape	AITAPE, WEWAK, VANIMO: Indurated, poorly sorted polymictic conglomerate and sandy conglomerate; poorly consolidated lithic sandstone, locally pebbly and calcareous in places; poorly consolidated siltstone and pebbly and foraminiferal siltstone; thinly interbedded graded fine silty sandstone and sandy siltstone; minor limestone, partly sandy and pebbly	Dep in shallow-water or fluv envir, but also by t.c. and rock slides in deeper water. Conf on and grades later into Amogu Cgl and Puwani Lst; unconf on Bliri Volc, U, Torricelli Intr Comp, Ambunti Metam, Prince Alexander Comp; locally nonconf below Lumi Fm; probably conf below Barida Beds; probably unconf below Tp, Nopan Sst, Wuro Beds?; unconf below Wirui Lst, Maprik Mdst, Neumayer Beds; conf or disconf, locally unconf, below Sargum Cgl, Wewak Beds; conf? or disconf below Marabu Lst, Songaien Fm, and Molang Creek Fm. Dated by foram (1 N4-e 18, and partly 1 Te-e Tf)
Late Miocene	Tmsg e-l Miocene Member of Senu Beds (At least in part included in Tml[1])	probably to 2000	WEWAK: Hard to poorly consolidated, massive to thickly bedded, subangular to well rounded, granule to cobble polymictic conglomerate, sandy conglomerate and partly carbonaceous conglomeratic medium to very coarse silty lithic sandstone	Lenses in Senu Beds; Mio (N8-N18) plank foram dates; locally faulted against Senu Beds with Mio (N8) dates; may include some Amogu Cgl. Plant debris

Units not differentiated, at least in part, from Tmu[1] on 1:1 000 000 map: In Aitape: Pleist-Holo Qa (see Qa[1]); Pleist Neumayer Beds (see Qs[1]); 1 Plio-Pleist Serra Hills Lst, 1 Plio? Romi Fm, 1 Plio Maprik Mdst, Plio Bewani Fm, Gwenif Fm, and Lumi Fm and e Plio Ipe Fm, Kumal Marl Mem, Misa Fm, Molang Creek Fm, and Songaien Fm (see Tp[1]); e-m Mio Puwani Lst (see Tmm[1]); L Cret-e Mio Torricelli Intr Comp (see Tml) and L Cret?, Eo-e Mio Bliri Volc (see KuTe[1]). In Vanimo: 1 Plio-Pleist Serra Hills Lst, 1 Plio?-Pleist? Bulimp Fm, Plio Bewani Fm, and 1 Plio? Romi Fm (see Tp[1]); Paleo?-e Mio Bliri Volc (see KuTe[1]); and L Cret-e Mio Torricelli

Intr Comp (see Tml). In Wewak: l Plio? Romi Fm, Plio-Pleist? Maprik Mdst, and e Plio Ipe Fm, Kumal Marl Mem, Marabu Lst, Misa Fm, Songaien Fm, Molang Creek Fm, and Sargum Cgl (see Tp^1); L Cret-e Mio Torricelli Intr Comp (see Tml); and Paleo?-e Mio Bliri Volc (see $KuTe^1$)

Tmm^1	Wogamush Beds (Tmw) m-l Miocene	at least 2400; volc. 300 max	E-CENTRAL MAY RIVER, W AMBUNTI: Micaceous sandstone and subgreywacke, siltstone, grit, calcarenite, conglomerate; limestone; intermediate and basic volcanics or volcanolithic conglomerate at base	Unconf on Ambunti Metam and April Ultram; probably overlies Salumei Fm and intruded by Frieda Po. Tf_{1-2} Stage foram in lst lenses near base; age of up part not known, but unlikely to be younger than Mio. (Dow et al., 1972, p.54)
	Burgers Formation (Tmb) l Miocene	1800	NE WABAG, SW AMBUNTI: Greywacke, tuffaceous sandstone and grit, crystal tuff, volcanic cobble conglomerate, calcarenite; minor coralline limestone	Volc mem at base apparently unconf on Pundugum Fm; where mem absent sed rocks apparently unconf on Pudugum Fm; top faulted. Tf_{1-2} foram. (Dow et al., 1972, p.51)
Middle Miocene	Tarua Volcanic Member (Tmu) of Burgers Formation m-l Miocene	2700 max; generally less than 1500	NE WABAG: Intermediate and basic volcanic rocks; minor conglomerate, sandstone, siltstone	Apparently unconf on Pundugum Fm; forms base of Burgers Fm, into which grades up and later. M Mio foram (Tf_{1-2}) at base, probably entirely Tf_{1-2} age. (Dow et al., 1972, p. 53)
	Karawari Conglomerate (Tmk) m-l Miocene	at least 600	S AMBUNTI: Pebble and cobble conglomerate, pebbly sandstone; thick lenses of basic and intermediate volcanic rocks at base	Strat relat not clear; equiv of Tarua Volc Mem and Burgers Fm in S, and of Wogamush Beds to W of map area. Unfoss. (Dow et al., 1972, p. 49)
	Puwani Limestone (Tmd) e-m Miocene (At least partly included in Qa^1, Tp^1, Tmu^1, Tml, Jt^1)	less than 100 in Wewak; less than? 500 in Vanimo	AITAPE, WEWAK, VANIMO: Massive to nodular bedded coralgal reef limestone, sandy and pebbly limestone, pelletal biosparite; some biopelsparite, interclast-bearing biosparite, limestone grit; minor sandstone, siltstone, conglomerate. In Vanimo, also interbedded foraminiferal marl, calcareous siltstone, and thin limestone; recrystallized limestone, sandy and pebbly limestone	Probably dep as fringing reefs and atolls, or on isolated shallow-water carb platforms in well aerated, shallow, agitated water alternating with somewhat deeper water close to terr source. Equiv of Amogu Cgl and some Tmsg; later equiv of, conf below, and usually basal to Senu Beds, but some lst lenses also higher in succession; unconf on Bliri Volc, Torricelli Intr Comp, Prince Alexander Comp, Amanab Metadr, Ambunti Metam; disconf? below Misa Fm. In Aitape and Vanimo, conf? below Barida Beds, and in Vanimo

	Tmm^1 (contd)			non-conf below Romi Fm; unconf below Serra Hills Lst, Neumayer Beds, younger units; in Aitape, unconf below Tp, Neumayer Beds. Carbonate dep widespread at this time, so other probable partial corr include: Gowop Lst of Adelbert, Finisterre, and Saruwaged Ras; Yalam Lst of New Britain; and Darai Lst of W Papua. In Wewak dated by abd larger benth foram as (1 Te-e Tf) Mio; in Aitape as both e (1 Te) and m (1 Tf) Mio; in Vanimo as m and 1 Mio (N10-14)
	Amogu Conglomerate (Tma) e-m Miocene (At least partly included in Tml^1, Tml, Jt^1)	to c.300	AITAPE, WEWAK: Conglomerate: indurated hard to poorly consolidated, unbedded to poorly or thickly bedded, poorly sorted, partly sandy, pebble to boulder grade; subordinate conglomeratic silty lithic sandstone and pebbly limestone	Of shallow-marine or fluv origin, and at least partly displaced into deeper water by t.c. Thickens and thins, and changes lithofacies later into Senu Beds and Puwani Lst; locally overstepped to E, probably unconf, by Plio rocks; conf below Senu Beds; unconf on Torricelli Intr Comp, Prince Alexander Comp, and Bliri Volc. Age from superpos and later relat with Puwani Lst and Senu Beds. Water-worn wood frag and rolled corals common
Middle Miocene	Units not differentiated, at least in part, from Tmm^1 on 1:1 000 000 map: In Wewak: Plio?-Pleist? Ulahau Fgl (see Qs^1); e Plio Sargum Cgl (see Tp^1); E Cret-e Mio Prince Alexander Comp (see Tml); and L Cret-Eo Ambunti Metam (see $KuTe^1$, Ku^2)			
Tmm	Oipo Intrusives (Tmi) m Miocene (At least partly included in To^1, Ju^1; Tmm in Region 3)		RAMU, SW BOGIA: See Tmm in Region 3	

Tmm (contd)	Maramuni Diorite (Tmm) m Miocene	NW RAMU: Porphyritic and non-porphyritic hornblende diorite and microdiorite; leucocratic biotite-hornblende granodiorite; less common augite-hornblende gabbro, hornblende-biotite rhyodacite, porphyry, and medium-grained biotite-augite monzonite; hornblende andesite and dolerite	Part of large batholith, but also forms small satellite bodies; more extensive in Ambunti and Wabag; corr with Kimil Dr, Bismarck Intr Comp, and Oipo Intr. 11-12.5 m.y. old by K-Ar method
		SE MAY RIVER, S AMBUNTI, NE WABAG: Diorite, granodiorite, intermediate porphyry, gabbro*	Intr ranging from batholiths to small dykes; split up into Yuat intr, Karawari intr, and Porgera intr. Some Pt and Au shed from unit concentrated in Timun R lake beds. (Dow et al., 1972, p.64-70)
Middle Miocene	April Ultramafics (Tma) m Miocene	S MAY RIVER, AMBUNTI, N WABAG: Serpentinite, peridotite, dunite, pyroxenite, anorthite gabbro*	Numerous bodies of various sizes. Probably related to ultram in N fall of central ranges of Irian Jaya. Intrude Salumei Fm; unconf below m Mio (Tf_{1-2}) Karawari Cgl and Wogamush Beds. (Dow et al., 1972, p. 62)

Units not differentiated, in part, from on 1:1 000 000 map: In May River and Ambunti: M Triassic? Ambunti Metam (see Rm-u[1])

Tml[1]	Frieda Porphyry (Tmx) m Miocene	CENTRAL MAY RIVER: Hydrothermally altered hornblende andesite porphyry and tuff, quartz diorite, minor monzonite*	Stocks, dykes, and larger intr bodies. May consist of intr of two ages: in S intrude e Tf_{1-2} Stage; in N intrude Ambunti Metam and might be older than m Mio. Po Cu-type mineraliz where intrudes Wogamush Beds. (Dow et al., 1972, p.70, 81)
Early Miocene	Tm Miocene	WABAG: Calcareous siltstone, marl; some calcareous quartz sandstone; minor pebbly sandstone; local limestone	Slumped calc beds (Dow et al., 1972, p. 48)

Units not differentiated, at least in part, from Tml[1] on 1:1 000 000 map: In Aitape: Plio Wewak Beds and e Plio Boini Beds, Misa Fm, Songaien Fm, and Molong Creek Fm (see Tp[1]); Mio Senu Beds (see Tmu[1]); and L Cret-e Mio Torricelli Intr Comp (see Tml). In Wewak: Plio Wewak Beds and e Plio Misa Fm, Songaien Fm, Boini Beds, and Molang Creek Fm (see Tp[1]); Mio Senu Beds and Tmsg (see Tmu[1]); e-m Mio Amogu Cgl (see Tmm[1]); and L Cret-e Mio Torricelli Intr Comp (see Tml). In Ambunti and Wabag: l Oligo?-e Mio Pundugum Fm (see To[1])

Tml	Mount Turu Complex (Tt) Jurassic?, some e Miocene	WEWAK: Predominantly serpentinite, websterite, clinopyroxenite, wehrlite, lherzolite, troctolite, gabbro, olivine diorite; some diorite, rare dolerite, and biotite adamellite	In partly faulted and partly intr? contact with Ambunti Metam and unconf below Maprik Mdst, Sargum Cgl? to S; unconf below Sargum Cgl, Wewak Beds, Ulahau Fgl? to N. K-Ar age of biotite adamellite 18.2 ± 0.8 m.y.; probably spurious K-Ar age (one gabbro sample) of 188 ± 50 m.y.; some areas of slightly anomalous Ni; possible source of road-making agg
Early Miocene	Torricelli Intrusive Complex (KTt) L Cretaceous-e Miocene (At least partly included in Tmu[1], Tml[1], KuTe[1], Jt[1])	AITAPE, WEWAK, VANIMO: Medium-grained gabbro, olivine gabbro, hornblende gabbro, dolerite, pyroxene diorite, diorite, monzonite; subordinate granodiorite and adamellite; rare pyroxenite, hartzburgite, pegmatitic and porphyritic equivalents of some types; minor serpentinite and sheared gabbro in large shear zones	Intrudes Bliri Volc; unconf below Amogu Cgl, Puwani Lst, Senu Beds, Neni Fm?, Tmg, Qa, Qm, Sargum Cgl, Wewak Beds, Maprik Mdst in E. Several K-Ar dates range from 73.2 to 17.3 m.y. Minor alteration and sulphide mineraliz along shears; mineralized po source of some alluv Au; possible source of road-making agg
	Prince Alexander Complex (KTp) E Cretaceous-e Miocene (At least partly included in Tmm[1], Jt[1])	WEWAK: Mostly crushed and mylonitized, fine to medium granodiorite and diorite; also metadiorite, dolerite, amphibolite, and orthogneiss; subordinate mica schist, biotite adamellite, biotite granodiorite, and porphyry dykes	Intensely faulted with confused relat; faulted contacts with Ambunti Metam; unconf below Puwani Lst, Amogu Cgl in W, and Amogu Cgl, Sargum Cgl, and Ulahau Fgl in E. High-grade metam and some sheared intr dated by K-Ar method as 106-114 m.y. (probably oldest); adamellites and po dykes less deformed and dated by same method as 19.9-22.5 m.y. (probably youngest)

Units not differentiated, at least in part, from Tml on 1:1 000 000 map: In Aitape: l Plio-Pleist Nopan Sst (see Qs^1); l Plio Maprik Mdst (see Tp^1); l Mio-e Plio Barida Beds and Mio Senu Beds (see Tmu^1); e-m Mio Puwani Lst and Amogu Cgl (see Tmm^1); and L Cret-Eo Ambunti Metam and Paleo?-e Mio Bliri Volc and pre-Oligo? Amanab Metadr (see $KuTe^1$). In Vanimo: e-m Mio Puwani Lst (see Tmm^1); Paleo?-e Mio Bliri Volc (see $KuTe^1$); and pre-Mio? U (see Jt^1). In Wewak: Plio?-Pleist? Ulahau Fgl (see Qs); Plio-Pleist? Maprik Mdst and Plio Wewak Beds (see Tp^1); and Paleo?-e Mio Bliri Volc (see $KuTe^1$). In Ramu: Eo-Oligo? Wulamer Beds (see To^1)

To^1	Pundugum Formation (Tms) l Oligocene?-e Miocene (At least partly included in Tml^1)	c.4000	S AMBUNTI, N, NE WABAG: Greywacke, tuffaceous greywacke, siltstone, fine pebble conglomerate; some small lenses of limestone	Overlies Ambunti Metam, probably with angular unconf; overlain, probably unconf, by Karawari Cgl, and by Tarua Volc Mem to S. Te Stage. (Dow et al., 1972, p. 43)
	Tom l Oligocene? (Included in Tp^1, Jt^1)	to 300	W AITAPE: Massive coralgal reef limestone, recrystallized limestone and pelletal biosparite, partly argillaceous; thin sandy siltstone and conglomeratic coarse lithic sandstone locally at base	Unconf on Ambunti Metam, Amanab Metadr; unconf under Tp, Qa. Probably l Oligo on larger benth foram, but may include some e Mio. Erosional hiatus between Tom and Senu Beds
Oligocene	Wulamer Beds (Tow, Tew) Eocene. Oligocene? (At least partly included in Tml, $KuTe^1$)	1500-3700	N RAMU: Phyllitic shale and slate, sheared calcareous sandstone, stretched pebble conglomerate, massive volcanic agglomerate, and interbedded siltstone and some cherty mudstone; laminated finely crystalline limestone	Possibly unconf on Asai Sh, but contact mostly faulted; top appears faulted against Ramu-Markham Fault Zone; intruded by small gb and ultram bodies of Oipo Intr. Age unknown, possibly Oligo?
		3500	SW BOGIA: Greywacke sandstone and siltstone; subgreywacke, massive, weakly calcareous, with interbedded conglomerate beds of identical composition; shale, minor volcanics, foraminiferal biomicrite; interbedded argillite most common at base, non-calcareous, slightly cleaved	Dep on steep submarine slope and in deep, probably fault-bounded trough. Possible grad boundary with Asai Sh, which they conf overlie; may extend into L Cret-Eo Asai Sh. Dated by foram as Eo

Units not differentiated from To^1 on 1:1 000 000 map: In Bogia: m Mio Oipo Intr (see Tmm)

KuTe[1]	Amanab Metadiorite (KTm) pre-Oligocene? (Included in Tml)		AITAPE: Predominantly sheared weakly foliated metadiorite, subordinate metagabbro, and metagranodiorite intruded by dolerite dykes. Original intrusives partly or completely converted to chlorite, epidote, secondary quartz, and clinozoisite	Appears to grade into Ambunti Metam in places, although probably intruded into Ambunti Metam before metam; unconf under Senu Beds, Puwani Lst, Tom, Tp, Border Mtns Lst Beds, and Qa. Source of road-making agg; possible source of alluv Au around Amanab
	Nebilyer Limestone (Teon) m Eocene-e Oligocene	100	W RAMU: See Tel-ol[2] (see under Region 2)	
	Dimaie Volcanics (Ted) l Eocene (Included in Qa[1])		AITAPE: Chloritized amygdaloidal basalt; some andesite, submarine lava breccia, agglomerate; minor tuff; basic dykes and small intrusives	Unconf under Qa. Dated by K-Ar method as 39.6 m.y.
Late Cretaceous - Eocene	Bliri Volcanics (Tb) Paleocene?-e Miocene (in Wewak); L Cretaceous?, Eocene-e Miocene (in Aitape) (At least partly included in Tmu[1], Tml, Jt[1])	2500-10 000	AITAPE, VANIMO, WEWAK: Basic, intermediate, and minor acid volcanics, and volcanically derived sediments with minor limestone lenses; volcanics include basalt, pillow basalt (brecciated and fragmented), basaltic tuff, agglomerate, breccia, andesite, andesitic tuff and agglomerate, lava, peperite; rare dacite and rhyolite; sediments include moderately indurated mudstone, pebbly mudstone, siltstone, and lithic sandstone with abundant volcanic detritus and minor agglomerate; lenses include radiolarian and foraminiferal marl and foraminiferal bioclastic limestone	Consist of two units: older of Paleo-l Eo age, with smaller sed component, more basic volc, and common deeper-water marls; younger of l Oligo-e Mio age, of greater sed component, more andesitic volc, and more common shallow-water calcaren. Dated by foram, but one K-Ar age of 30.4 m.y. for bs. Intruded by Torricelli Intr Comp; in places unconf below Amogu Cgl, Puwani Lst, Senu Beds, Wewak Beds, Wirui Lst, Barida Beds, Romi Fm, Serra Hills Lst, Neni Fm?, and Neumayer Beds

Late Cretaceous - Eocene

KuTe[1] (contd)	Ambunti Metamorphics (KTa, KTal) L Cretaceous-Eocene (At least partly included in Qa[1], Tmm[1], Tml, Jt[1])		AITAPE, WEWAK: Phyllite, quartz-mica schist, quartz-epidote-mica schist, garnet-mica schist; subordinate shale; slate and metasediments with limestone lenses, marble, and metavolcanics; minor amphibolite and gneiss locally. Nummulitic limestone separated out as KTal.	Lithology variable. Locally unconf below Puwani Lst, Senu Beds, Maprik Mdst, Sargum Cgl, Tp, Tom, Border Mtns Lst Beds, Lumi Fm, and Wosera Beds; probably intruded by Amanab Metadr. Minor dissem py mineraliz, but little economic potential; local alluv Au probably derived from intruding po. Long narrow lenses of KTal contain larger benth foram
			MAY RIVER, AMBUNTI: Slate, phyllite, sericite schist, muscovite and biotite schist; pelitic, quartzofeldspathic, and basic gneiss; schists and gneisses of amphibolite facies	Unconf under Wogamush Beds and Karawari Cgl; later equiv of Gwin Metam; possibly under unaltered Cret seds. Older than m Mio, probably Mesoz, but possibly includes E Tert rocks. Metam e Mio or older
	Salumei Formation (metamorphic phase) (Tls) Cretaceous-l Eocene (At least partly included in Qa[1], Tmm[1], Tml[1], Jt[1], Ku[2], Jm-u[2])	3000+	S MAY RIVER, AMBUNTI, N WABAG: Metamorphic phase: slate, phyllite, sericite schist, metagreywacke; recrystallized limestone and greenschist in places*. Non-metamorphic phase: mostly fine siltstone and shale, subgreywacke, and lenses of limestone and calcarenite; submarine agglomerate and lavas; rare volcanolithic pebble conglomerate in places*	Contact between Salumei Fm (Tls) and Gufug Gn faulted, but field evidence suggests grad contact between two. Metam are equiv of Salumei Fm. Base not seen; contacts with older units faulted except locally where possibly rests conf on Jur Sitipa Sh; unconf below Pundugum Fm and Wogamush Beds. L Cret-Eo foram; possibly Neocomian amm. Some Cu mineraliz locally. (Dow et al., 1972, pp. 25, 82)
	Asai Shale (KuTa) L Cretaceous-Eocene (At least partly included in Ju[1])		NW RAMU: Phyllitic, schistose, and commonly carbonaceous shale and siltstone; fine greywacke, minor limestone, calcarenite, and conglomerate	Most rocks undergone low-grade (low greenschist facies) regional metam; conf on Kumbruf Volc; numerous ramifying qtz and calcite veins; minor leucocratic acid dykes; corr of Chim Fm. Dated by foram in some 1st lenses
	Chim Formation (Kuc) Cenomanian-Maastrichtian		W RAMU: See Ku[3] (under Region 3)	

	KuTe[1] (contd)	BOGIA: Shale, with fissile slaty cleavage or subconchoidal fracture; greywacke with interbedded conglomerate; clasts of quartzite and fine siliceous sediments; calcareous argillite; well bedded foraminiferal biomicrite forms thin lenses widely scattered throughout unit	Marine shelf which received fine terr sed, but small amount of reef detritus. Similar to Gusap Arg, which may be partly equiv; possibility of continuous dep of Asai Sh through to Gusap Arg; passes up by mixed gradation into Wulamer Beds; conf on Kumbruf Volc. Dated by plank and smaller benth foram; sponge spicules also present
Late Cretaceous - Eocene	Gufug Gneiss (Tmg) Cretaceous-Eocene	SE MAY RIVER: Glaucophane schist and gneiss with variable epidote, garnet, and white mica; eclogite*	Apparently as fault wedges in Salumei metam, but possible trans from Gufug Gn to Salumei metam; probably equiv to Salumei metam in age; metam probably in post-Eo and pre-m Mio. (Dow et al., 1972, p. 39)
	Mum Jurassic?	SW BOGIA: Serpentinite, dunite, peridotite, pyroxenite, gabbro (cumulate), chlorite schist, hornblendite; one small intrusion of harzburgite with some dunite, lherzolite, and associated dolerite	Possibly remnants of thrust sheet of Mesoz oceanic crust emplaced in Eo; possibly equiv to Marum Basic Belt

Units not differentiated, at least in part, from KuTe[1] on 1:1 000 000 map: In Aitape: Mio Senu Beds (see Tmu[1]). In Wewak: Pleist-Holo Qa and Wirui Lst (see Qa[1]); Plio Wewak Beds and e Plio Sargum Cgl (see Tp[1]); and Mio Senu Beds (see Tmu[1]). In Ramu and Bogia: Eo-Oligo Wulamer Beds (see To[1]). In Aitape, Wewak, and Vanimo: L Cret-e Mio Torricelli Intr Comp (see Tml)

Jurassic-Oligocene	Jt[1] U pre-Miocene? (At least partly included in Tml)	AITAPE, VANIMO: Mainly sheared serpentinite	Faulted against Bliri Volc, Senu Beds, Puwani Lst, Ambunti Metam, Dimaie Volc. Serp in sheared zone in Puwani Lst; minor anomalous lateritic Ni

Units not differentiated, at least in part, from Jt[1] on 1:1 000 000 map: In Wewak: Mio Senu Beds (see Tmu[1]); e-m Mio Amogu Cgl and Puwani Lst (see Tmm[1]); L Cret-e Mio Torricelli Intr Comp and E Cret-e Mio Prince Alexander Comp (see Tml); and Paleo?-e Mio Bliri Volc and L Cret-Eo Ambunti Metam (see KuTe[1]). In Aitape: Pleist-Holo Qa (see Qa[1]); Plio Neni Fm? and Rofula Mem (see Tp[1]); Mio Senu Beds (see Tmu[1]); e-m Mio Puwani Lst and Amogu Cgl (see Tmm[1]); L Cret-e Mio Torricelli Intr Comp (see Tml); l Oligo? Tom (see To[1]); and L Cret-Eo Ambunti Metam and L Cret?, Eo-e Mio Bliri Volc (see KuTe[1]). In Vanimo: Paleo?-e Mio Bliri Volc (see KuTe[1])

Late Jurassic	Ju^1	Kompiai Formation (Juk) L Jurassic?		NW RAMU: Siltstone, laminated greywacke siltstone and sandstone; phyllitic shale, schistose shale, phyllite, highly indurated cleaved shale; minor calcareous sandstone	Apparently conf below Kumbruf Volc; corr of Maril Sh
		Sitipa Shale (Jus) Kimmeridgian		W AMBUNTI: Calcareous siltstone and shale, fine greywacke	Generally bounded by faults, but in places possibly conf below Salumei Fm; later equiv of Maril Sh. Age Kimmeridgian on biv Malayomaorica. (Dow et al., 1972, p. 22)
		Maril Shale (Jmm) Kimmeridgian	2400+	SE AMBUNTI, NE WABAG: Calcareous shale and siltstone, greywacke, quartz sandstone*. See also under Region 3	Dep in NW-trending trough between Maramuni R and head of Jimi R. Intruded by Maramuni Dr, and hornfelsed near contact; in places altered to phyllite. Thins to S. L Jur on biv Malayomaorica and Inoceramus. (Dow et al., 1972, p. 22)
	Units not differentiated from Ju^1 on 1:1 000 000 map: In Bogia: m Mio Oipo Intr (see Tmm); and L Cret-Eo Asai Sh (see $KuTe^1$). In Ramu: L Cret-Eo Asai Sh (see $KuTe^1$)				
Early-Middle Jurassic	$J1\text{-}m^1$	Mongum Volcanics (Jmm) M Jurassic	240-900	SE AMBUNTI, NE WABAG: Submarine basic volcanics and tuffaceous sediments, limestone, chert*	Conf on E Jur Balimbu Gwke and conf below L Jur Maril Sh. Unfoss. (Dow et al., 1972, p. 21)
		Balimbu Greywacke (J1b) Sinemurian-Pliensbachian		NW RAMU: See $J1\text{-}m^3$ (under Region 3)	
	Unit not differentiated, at least in part, from $J1\text{-}m^1$ on 1:1 000 000 map: Carnian-Norian Kana Volc (see Ru^1)				
Late Triassic	Ru^1	Kana Volcanics (Ruk) Carnian-Norian	600+	SE AMBUNTI, NE WABAG: Dacite, rhyolite, and andesite tuffs and lavas, tuffaceous sandstone, dacite pebble conglomerate, tuffaceous siltstone	Overlies Jimi Gwke, probably unconf; below E Jur Balimbu Gwke. Dated by fairly widespread L Trias molluscs; may range into E Jur. (Dow et al., 1972, p. 20)
				CENTRAL NW RAMU: See Ru^3 under Region 3	

Middle Triassic	$Rm\text{-}u^1$	Yuat Formation (Rmy) Anisian-Norian	600+	SE AMBUNTI, NE WABAG, NW RAMU: Shale, greywacke, feldspathic sandstone*	Base not exposed; overlain, probably conf by Kana Volc. Contains amm, nautiloids, biv, and crinoid stems; dated M-L Trias. (Dow et al., 1972, p. 19)
		Chambri Diorite (Mc) (Age not known, possibly Triassic)		AMBUNTI: Diorite, granodiorite, gabbro*	Intrudes Ambunti Metam (Dow et al., 1972, p. 62)
		Hunstein Complex (Mns) M Triassic		W AMBUNTI: Metamorphosed gabbro, quartz-biotite gneiss*	Exposures poor and relat of various rock types not known. (Dow et al., 1972, p. 60)
	Unit not differentiated, at least in part, from $Rm\text{-}u^1$ on 1:1 000 000 map: In Ramu: Quat Hagen Volc (see Qv^3)				
Permian	P	P Permian		W AITAPE: Mainly biotite and hornblende medium to coarse granodiorite, diorite, and quartz diorite; subordinate hornblende tonalite, leucocratic granophyre and dolerite	Observed only as boulders derived from Irian Jaya. Dated by K-Ar method as 242-257 m.y.; assoc with cobbles and pebbles of dacitic volc; relat with Ambunti Metam unknown

SOUTHERN AND WESTERN HIGHLANDS AND FLY RIVER (2)

Age	IM map unit	Constituent unit(s) in 1:250 000 Sheet areas	Thickness (m)	Lithology	Additional pertinent data
Quaternary	Qa^2	Qa Holocene (At least in part included in Qs^2)		WABAG, S KARIMUI, DARU-MAER: Clay, sand, silt, gravel, peat, alluvial soil; tuffaceous sand locally	Coastal and river alluv
		Qs Pleistocene (At least in part included in Tou-mm^2)	to 500	CENTRAL, N BLUCHER RANGE: Chaotic deposits of angular rock fragments, slumped slate, shale; includes some Qa	As landslip aprons. Unconf on older rocks. Not suitable for building foundations unless lithified and well drained; some buildings at Lake Kopiago on Qs
		Qpm Pleistocene (At least in part included in Tou-mm^2)	to 20	NW BLUCHER RANGE: Glacial moraine: probably unsorted mass of limestone rock fragments	S slope of Mt Capella at about 3500 m elevation; photo-interpreted; unconf on Darai Lst
	Qv^2	Suaru, Karimui, and Hagen Volcanics (Qvs, Qvk, Qvh) Quaternary		KARIMUI: See Qv^3 (under Region 3)	
		Duau, Mt Murray, Ialibu, and Giluwe Volcanics (Qvd, Qvm, Qvi, Qvg) Quaternary		KARIMUI: Basalt (shoshonitic) to andesite lava, agglomerate, tuff; minor derived sediments	Poorly to well preserved volc cone forms; all extinct; some small satellite vents may be as young as 1000 years
		Maer Volcanics (Qpm) Pleistocene?		DARU-MAER: Olivine basalt and tuff; hawaiite-mugearite composition	Tuff contains coral frag; three well preserved cones in Murray Is

Qv^2 (contd)	Sugarloaf Volcanics (Qs) Quaternary		SE WABAG: Basalt and andesite lavas and tuffs; recent cumulodomes of unknown composition	Lava field of coalescing cumulodomes, with explosion craters. Younger than Giluwe Volc and probably Hagen Volc. (Dow et al., 1972, p. 59)
Qs^2	Qt Quaternary		DARU-MAER: Alluvium in terraces	Forms older inland coastal plain
	Qa, Qa_1 Pleistocene	to 600	BLUCHER RANGE: Alluvium and older alluvium: gravel, sand, silt, mud; moderately or weakly lithified conglomerate, sandstone, siltstone, mudstone; includes some lake beds and Qs	Alluv: unconf on Darai Lst and Birim Fm; disconf and conf on Awin Fm; source of gv; where tested contains very little Au. Older alluv: in various highland valleys, some swampy in parts with sphagnum bog on carb muds; older parts later equiv of Awin Fm; unconf on older rocks; source of gv; generally stable and suitable for building foundations, except on steep slopes
Quaternary	Sisa Volcanics (Qps) Pleistocene (At least in part included in Tp^2)	to 500	SE BLUCHER RANGE: Agglomerate and tuff, andesitic where sampled	One small outcrop: outlier of apron of Mt Sisa volcano (Lake Kutubu). Overlies Wongop Sst with slight angular unconf. Age from degree of dissection of Mt Sisa volcano. Source of gv
	Awin Formation (Qpa) Pleistocene	to 500	S, SW BLUCHER RANGE: Sandstone, conglomerate, siltstone, mudstone, thin lignite seams; some white sandy clay	Former alluv with cut-and-fill struc; generally lower dips and lack of tuff and aglm distinguish it from Birim Fm. Later equiv of most Qa; paraconf and locally unconf? on Birim Fm; unconf on Darai Lst, Liddle Cgl, and Wongop Sst; disconf and conf below Qa. Age from strat position. Source of gv; where tested contains very little Au

Units not differentiated, at least in part, from Qs^2 on 1:1 000 000 map: In Daru-Maer: Quat Qa (see Qa^2); Plio-Pleist TQs (see TpQp); and Mio Tm (see Tou-mm^2)

Pliocene - Quaternary

TpQp	TQs Pliocene-Pleistocene (At least in part included in Qs[2])	to 120	DARU-MAER: Mudstone, sandstone, gravel; terrigenous	Overlies Mio 1st
	Intrusives, Star Mountains Intrusives (Tpi, Tps) 1 Miocene-Pleistocene		E, NW BLUCHER RANGE: Porphyritic micromonzonite and microdiorite, minor medium-grained equivalents; magnetite, sulphide, and epidote-garnet skarns	Intr: forcefully emplaced; probably related to po sills S of Lake Kopiago; most or all stocks subvolc, and source? of volc component in Birim Fm, Wongop Sst, Liddle Cgl, and Awin Fm; intr Plio?, Mio, and older sed; age 2-5 m.y. from several K-Ar determinations; similarity to Fubilan stock suggests possibility of some Cu, Mo, Ag, and Au mineraliz; some Cu and Zn in Bolivip stock; some Pb and Zn in skarn assoc with sills on S bank of Lake Kopiago. Star Mtns Intr: cluster of small stocks and one larger body (Antares Monz); comp similar to Tpi, but some more potassic; some stocks subvolc and source of volc component of Birim Fm and Awin Fm; intrude Plio? and older sed; age 1.2 or 2 to 5 m.y. from many K-Ar determinations; Cu mineraliz in several stocks in Tifalmin area
	Fubilan stock (Tpf) 1 Miocene-Pleistocene		NW BLUCHER RANGE: Quartz monzonite porphyry*	Vertical cylinder. Age of potash metasomatism (and mineraliz) 1.2 m.y. from eight K-Ar determinations. Dissem and skarn Cu mineraliz estimated at 200-300 million tonnes 0.9% Cu; assoc minor Mo, Ag, Au
	Mount Ian gabbro (Tpg) 1 Miocene-Pleistocene		NW BLUCHER RANGE: Pyroxene-bearing gabbro phase within generally felsitic intrusive complex	Part of Star Mtns Intr
	Antares Monzonite (Tpa) 1 Miocene-Pleistocene		NW BLUCHER RANGE: Monzonite, granodiorite, adamellite, fine-grained porphyritic equivalents, minor tuff, agglomerate, lava	Largest intr body in Star Mtns Intr. Much py, some Cu mineraliz; vegetation anomalies on SE contact (airphoto-interpretation) may indicate skarn

	Tp^2	Era Beds (TQe) Pliocene-Pleistocene	generally 300+	S KARIMUI: Fine to coarse well compacted sandstone, siltstone, and mudstone; thin shelly quartz sandstone beds	Marine and non-marine. Conf on Orubadi Fm. Coal seams, mainly in up part
		Birim Formation (Tpb) Pliocene	1450	W-CENTRAL BLUCHER RANGE: Sandstone, conglomerate, tuff; minor agglomerate; shelly sandstone and tuffaceous marl at base; rare lignitic claystone near top; conglomerate clasts mostly Tmd-type limestone and Tps/Tpi porphyry	Mostly former alluv; basal part marine. Corr of Wongop Sst and Liddle Cgl; paraconf and in places unconf? on Pnyang Fm and Warre Lst Mem. Age based on strat position and on corr of volc with Tpi igneous activity (2-5 m.y.). High Cu in some stream-sediment samples apparently due to dissem rather than visible economic Cu mineraliz; source of gv
Pliocene		Liddle Conglomerate (Tpl) Pliocene	c.100	SE BLUCHER RANGE: Conglomerate, partly volcanic, partly polymictic; clasts include Darai Lst and Tpi porphyry; some agglomerate, tuff, silty sandstone	Probably former alluv dep. Lenses out to SE. Later equiv of cgl part of Birim Fm; aglm and tuff distinguish it from Awin Fm; conf and in places unconf? on Wongop Sst; unconf below Awin Fm. Age on strat position and on corr of volc with Tpi igneous activity (2-5 m.y.). Source of gv; cliffs not regarded stable
		Wongop Sandstone (Tpw) Pliocene or younger	to 2400	SE BLUCHER RANGE: Sandstone, minor conglomerate, siltstone, shale; calcareous near base, tuffaceous, partly carbonaceous	Foram and lithologies indicate trans from marine at base through brackish to non-marine with rare marine intcal. Conf on Wai Asi Beds; conf and locally unconf below Liddle Cgl; unconf below Awin Fm and Sisa Volc. Age from strat position and 'Plio or younger' foram in Raggi; thin lignite seams near top; plant remains

Units not differentiated, at least in part, from Tp^2 on 1:1 000 000 map: In Blucher Ra: m Mio Tmx and m-l Mio Tmtz (see Tou-mm^2); and one small outcrop of Pleist Sisa Volc (see Qs^2)

Late Miocene	Tmu^2	Orubadi Formation (Tmup) l Miocene-Pliocene	100-750, av 350; thickens to E	S KARIMUI: Well bedded mudstone with carbonaceous laminae; subordinate siltstone and sandstone; minor hard calcareous sandstone	Conf on Darai Lst. Mdst possibly bentonitic in places. Shelly beds with large and small fossils (Tg-Th) abd

Tmu^2 (contd)	Wai Asi Beds (Tma) m?-l Miocene (Included in Tou-mm^2)	250	SE BLUCHER RANGE: Calcareous mudstone and siltstone with minor limestone beds; some glauconite	Later equiv? of Tmt and mdst phase of Pnyang Fm; conf on Darai Lst and conf below Wongop Sst. Shallow-marine foram and molluscs in some samples. Dated by plank foram
Tou-mm^2	Tm Miocene (At least in part included in Qs^2)	915	DARU MAER: Limestone, some dolomite; cherty mudstone and marl towards base	Dep in shallow water on stable shelf during major transgression. Subsurface in E
	Tmx m Miocene (At least in part included in Tp^2)		E BLUCHER RANGE: Thin-bedded limestone with mudstone, siltstone, sandstone interbeds	Later equiv? of Warre Lst Mem; conf on Tmt. Dated by plank and larger foram as e Tf
Late Oligocene - middle Miocene	Pnyang Formation and Warre Limestone Member (Tmp, Tmp_1, Tmr) m Miocene	200-1500; limestone horizon 20-40; member 90-200, average 110	CENTRAL W BLUCHER RANGE: Soft calcareous mudstone and siltstone with limestone interbeds; tuffaceous sandstone. Member fossiliferous fine-grained limestone with marl interbed; in W partly micritic; partly detrital with fossils and some tuff	Trans in NW to Iwoer Fm (thicker, more sandy, no lst); trans? in E to Wai Asi Beds or to top Darai Lst; disconf and unconf below Birim Fm. Dated by larger and plank foram as N9-14. Some sub-bituminous coal seams. Lst horizons discontinuous along strike. Mem conf on Pnyang Fm and Iwoer Fm; disconf and unconf below Birim Fm; intruded by Star Mtns Intr. Dated by larger benth foram (e Tf; 1 Te or e Tf), plank foram (N12), and nannoplankton (equiv of N8-9)
	Tmtz m-1 Miocene (At least in part included in Tp^2)	1200	N CENTRAL, E BLUCHER RANGE: Thinly bedded laminated silty mudstone and sandy siltstone; thin interbeds of fine micaceous sandstone; in places, calcareous siltstone includes some Tmt	Includes clastic sed which appear to occupy strat level of Tmt, but differ from it in being more sandy or apparently younger; includes Tmt and 'Orubadi Fm' (Wabag). Dated by foram as m Mio or younger in Lake Kopiago area; l? Mio or Plio in Sepik headwaters

Tou-mm^2 (contd)	Tmt e-m Miocene	1000	N BLUCHER RANGE: Marine mudstone and siltstone with thin very fine-grained calcareous sandstone interbeds	Dep in quiet, shallow sea. Corr with 'Lai Slst' of Mendi area; later equiv? of Wai Asi Beds and mdst phase of Pnyang Fm; conf on Darai Lst and conf below Tmx. Rich plank foram (N8, 9) includes reworked Paleo and L Cret elements
	Iwoer Formation (Tmi) e-m? Miocene	2500	NW BLUCHER RANGE: Calcareous mudstone, siltstone, silty quartz sandstone; rare lignite	Trans S and SE into Pnyang Fm marked by appearance of lst interbeds and probably decrease in proportion of sst; conf on Darai Lst; conf below Warre Lst Mem. Dated by foram. Lignite seams reported in Irian Jaya
	Chuingai Limestone (Tmc) 1 Miocene	to 60	WABAG: Coral and foraminiferal limestone	Unconf on Ambunti Metam. Contains Mio foram; probably 1 Mio (contains Tg foram to NW). (Dow et al., 1972, p. 57)
Late Oligocene - middle Miocene	Tm Miocene	300+	WABAG: Calcareous siltstone, marl, some calcareous quartz sandstone, and minor pebbly sandstone	Slumped calc beds. (Dow et al., 1972, p. 48)
	Yangi Beds (Tmy) 1 Oligocene?-m Miocene	c.1500	WABAG: Mudstone, marl, calcareous siltstone, sandstone; interbeds of limestone	Overlie Lagaip Beds probably unconf; grade N into Tibinin' Lst Mem. Te foram locally; uppermost beds probably Tf_{1-2}. (Dow et al., 1972, p. 47)
	Tibinini Limestone Member (Tmt) of Yangi Beds 1 Oligocene?-m Miocene	900-1200	WABAG: Calcarenite, limestone, some marl and calcareous shale	Unconf on Lagaip Beds; probably grades later into Yangi Beds. Uppermost beds contain Tf_{1-2} foram locally; low half probably Te Stage. (Dow et al., 1972, p. 48)
	Darai Limestone (Tr, Tr_1, Tmd) 1 Eocene-m Miocene, but mainly 1 Oligocene-m Miocene	500-1300 in Blucher Range	BLUCHER RANGE: Massive to thick-bedded limestone; slightly sandy and glauconitic foraminiferal biomicrite and pelsparite near base passes up into mainly algal foraminiferal biomicrite with sponge-bearing micrites, infrequent dolomitized	Folded into broad flat-topped anticline and disrupted by probably gravity-induced smaller folds and thrust-faults. Disconf on Feing Gp and Ieru Fm; conf below Pnyang Fm, Iwoer Fm, and Tmt; conf or disconf below Tmtz and Wai Asi Beds. Dated by foram (mainly e Te-Tf).

	Tou-mm^2 (contd)		beds, and cherty beds. Slumped limestone slab mapped as Tr_1	Algae and sponges. Some e Oligo (Tc), and m or l Eo (Ta_3-Tb) float at one locality. Source of lime; minor Pb sulphides at Lake Kopiago; possibility of skarn mineraliz where intruded by Tpi, Star Mtns Intr, etc.
		100-1200 thickens to S in Karimui	S, SE KARIMUI: Thick-bedded to massive biosparite, biomicrite, and calcareous arenite with minor biosparudite and breccia; calcareous quartz-feldspar arenites most common at base of sequence and especially in N-most outliers	
Late Oligocene - middle Miocene	Aure Beds (Tm) m Oligocene-l Miocene		KARIMUI, RAMU, SW MARKHAM: See Tml^4 under Region 4	
			SW RAMU: Thin-bedded to laminated calcareous mudstone and siltstone, and volcanolithic greywacke; minor siltstone and limestone	Basinal facies of Aure Beds, but much less extensive than in Karimui; formed in deep-water envir close to rapidly eroding landmass; provenance volc; extensively covered by Holo volc ash

Units not differentiated from Tou-mm^2 on 1:1 000 000 map: In Blucher Range: Quat Qs and Qpm (see Qa^2); and m?-l Mio Wai Asi Beds (see Tmu^2)

Eocene - early Oligocene	Tel-ol^2	Nebilyer Limestone (Teon) m Eocene-e Oligocene	100 in Ramu; less than 100 and thins to S in Karimui	NW KARIMUI, W RAMU: Calcarenite with thin silty argillaceous interbeds; fine-grained limestone	Corr of Chimbu Lst; contains plank foram (Ta_3-Tc) and algae
		Te Eocene	0-200, av 50-100 in Karimui	SE KARIMUI, SW MARKHAM: Fine to coarse detrital and micritic limestone; ferruginous, glauconitic, and calcareous quartz sandstone and sandy limestone; minor sandstone, siltstone, and mudstone	May include some e Oligo beds, e.g., Chimbu Lst in S and E Karimui; age Ta_2-Tb. In Markham possibly partly equiv to Chimbu Lst to N; possibly unconf below Aure Beds

Unit not differentiated from Tel-ol^2 on 1:1 000 000 map: In SW Markham: E Cret Ml (see Kl^2)

Ku^2	Salumei Formation (KTs) Cretaceous-l Eocene (At least part mapped as Jm-u^2)	More than 500	NE BLUCHER RANGE: Weakly schistose fine to coarse poorly sorted volcanolithic sandstone. See also KuTe^1 under Region 1	In other areas includes sltst, submarine basic volc, lst, and metam equiv; fault-bounded. Dated by foram in lst interbeds in adjoining areas
	Feing Group (undivided) (KTf, KTf$_1$) Valanginian, l Paleocene? or e Eocene?	1000-2000	N BLUCHER RANGE: Massive to well bedded fine sandstone, siltstone, and shale; clean and muddy hard quartz sandstone and quartzite, some cemented by grain overgrowth, partly glauconitic; rare dense fine-grained streaky limestone	In same strat interval as Toro Sst and Ieru Fm and of similar lithology, but lacks prominent sltst/sst which characterizes Ieru Fm; sst in KTf (KTf$_1$) partly younger than in Toro Sst; sltst and sh less carb and less indurated than sltst and sh of Om Beds (where seen contact faulted); trans in S into Toro Sst and Ieru Fm; disconf below Darai Lst. Dated by amm and foram. Most L Cret/Jur amm in float at several localities may indicate presence of unmapped Om Beds
Late Cretaceous	Chim Formation (Kuc) Cenomanian-Maastrichtian		SE KARIMUI: See Ku^3 (under Region 3)	
	Ieru Formation (Kui) Cenomanian-Campanian	670-890, rarely to 1500	CENTRAL, NW BLUCHER RANGE: Bioturbated fine glauconitic quartzose sandstone and siltstone, with recessive glauconitic mudstone and siltstone; abundant large cone-in-cone concretions; prominent beds of fine sandstone and siltstone in mid-section and at top	Later equiv of up part of Feing Gp; conf on Toro Sst from which distinguished by lack of clean qtz sst; disconf below Darai Lst under Fly-Strickland plains. Dated by foram and amm; also contains biv

Unit included in Ku^2 on 1:1 000 000 map: In Wabag: M Jur-Paleo Lagaip Beds (see Jm-u^2)

	$K1^2$	Toro Sandstone (JKt) L Jurassic?, Neocomian-Albian	150-435	CENTRAL BLUCHER RANGE: Clean well sorted quartz sandstone, friable or cemented by grain overgrowth; some mudstone, siltstone, and bioturbated silty micaceous sandstone; clean sandstone, coarse cross-bedded at base - beds 30 cm to massive	Probably dep under high-energy conditions as nearshore marine sand-bar complex. Later equiv of Feing Gp, some of which younger; conf on Kuabgen Gp; conf below Ieru Fm. Permeable; potential petrol reservoir rock; porosity reduced in places by grain overgrowth. Dated by spores and micropl; biv and blm also present
Early Cretaceous		K1 E Cretaceous	1200-1500 in Karimui	SE KARIMUI: Massive to thick-bedded dense lithic sandstone interbedded with thin-bedded mudstone/siltstone; minor shelly greywacke and limestone*	Some ripple marks. Equiv to Kondaku Tuff; overlain by Chim Fm. Dated by amm, gast as Aptian-Albian
				SW MARKHAM: Massive to thick-bedded lithic sandstone interbedded with thin-bedded mudstone and siltstone; minor shelly limestone	Subsurface only
	$Jm-u^2$	Lagaip Beds (J-Kp) M Jurassic-Paleocene (Included in Ku^2)	c.3000	WABAG: To W: Slate, shale, and siltstone, commonly pyritic; minor subgreywacke; thick beds of quartz sandstone towards top of unit. To E: lighter in colour and mostly calcareous; lenses of limestone and thin-bedded quartz sandstone common in places	Bottom not seen, but similar sed of Jur age unconf on granitic rocks in Strickland Gorge; probably unconf below e Mio marine sed. Amm of Callovian age; foram ranging from Albian? to L Cret and Paleo to m Eo. Little bornite found locally; at Porgera, Au mineraliz assoc with sphalerite, py, galena. (Dow et al., 1972, pp. 32, 82)
Middle - Late Jurassic	Kuabgen Group	Imburu Mudstone (Jui) Oxfordian	200-640	N BLUCHER RANGE: Predominantly micaceous mudstone and siltstone, partly calcareous with concretions; interbedded with fine flaggy silty micaceous quartz sandstone towards base; some mudstone and siltstone laminated; some sandstone has ripple-drift lamination	Inliers in core of Muller Anticline. In places indistinguishable photogeologically from Koi-Iange Sst, Atemin Sh; conf on Koi-Iange Sst; underlies Toro Sst; later equiv? of up Om Beds. Dated by amm, biv, micropl. Possible petrol source rock

Jm-u^2 (contd)	(Koi-Iange Sandstone (Jk) (Callovian-Kimmeridgian	290-550	N BLUCHER RANGE: Fine to coarse micaceous quartz sandstone, partly feldspathic; subordinate bioturbated sandy siltstone, mudstone; finer clastic intercalations locally more common near top; thin pebbly horizon and coal at base	Inliers in Muller Anticline not distinguishable photogeologically from Imburu Mdst and Atemin Sh in places; locally unconf on Strickland Gr; conf on Atemin Sh in W; conf below Imburu Mdst; later equiv? of low part of Om Beds; low part in Strickland valley probably later equiv of Atemin Sh and Bol Ark. Dated by rare amm and biv. Up part of unit has petrol reservoir potential in Strickland Gorge; elsewhere sst tight
	Atemin Shale (Ja) Oxfordian	90-120	NW BLUCHER RANGE: Hard, slightly micaceous silty shale, calcareous and sandy in part; scattered concretions	Inliers in core of Muller Anticline; not distinguished in places from Koi-Iange Sst; conf on Bol Ark, boundary grad in places; conf below Koi-Iange Sst and probable later equiv of part of it in E. Dated by biv, blm
Middle - Late Jurassic / Kuabgen Group	Bol Arkose (Jb) Bajocian? in part	to 710	N BLUCHER RANGE: Hard conglomeratic arkose, coarse poorly sorted, with subangular clasts of granite, adamellite, orthoclase; fine to coarse quartzose sandstone in upper part, partly feldspathic calcareous or silty; bedding thick or massive, distinct to poor	Inliers in axis of Muller Anticline; base not seen but possibly unconf on Strickland Gr at shallow depth; conf below Atemin Sh; later equiv? of low part of Koi-Iange Sst in Strickland valley. Bajocian? amm in probable Bol Ark locally
	Om Beds (Jo, Jo_1) 1 Bajocian-Tithonian; to Maastrichtian in Waba[illegible]	3000+	N BLUCHER RANGE: Carbonaceous siltstone and mudstone; minor fine quartz sandstone, pyritic chert nodules and lenses commonly with cone-in-cone structure, carbonate concretions, microdiorite dykes; some fine lithic sandstone	Complexly faulted (mostly E-W) and folded. Dep in shallow water in some places and by t.c. Later equiv of Kuabgen Gp; metam to N, where passes into Jom; base not exposed; conf? below Feing Gp, but contact faulted. Dated by amm; also blm, biv, wood. Possible petrol source rock; gas and minor oil shows in places
	Metamorphic Phase of Om Beds (Jom, Jom_1) 1 Bajocian-		NE BLUCHER RANGE: Carbonaceous schist, phyllite, and slate; minor less schistose fine quartzite; pyritic chert nodules and lenses	Complex struc dominated by WNW-trending faults; simpler struc (broad folds) in more competent sandy units. Faulted against Salumei Fm in N and against Om Beds in S; contact with Om Beds

$Jm\text{-}u^2$ (contd)		Tithonian		may be gradational elsewhere. Age from corr with Om Beds and from rare amm near contact with Om Beds
Middle-Late Jurassic		Unit not differentiated from $Jm\text{-}u^2$: In Blucher Range: Cret-1 Eo Salumei Fm (see Ku^2; also $KuTe^1$ under Region 1).		
Late Permian	Pu	Strickland Granite (Ps) L Permian?	E BLUCHER RANGE: Granite with chlorite, calcite, sericite, and epidote alterations	Unconf below Koi-Iange Sst. Age based on analogy with Kubor Gd (Ramu): 214 m.y. (K-Ar) or 240 m.y. (Rb-Sr); one sample of Strickland Gr dated at 214 m.y. (K-Ar)
Late Carboniferous	Cu	Badu Granite (Cub) L Carboniferous	DARU-MAER: Leucocratic biotite granites; porphyritic biotite granite and adamellite; some hornblende-biotite adamellite and granodiorite	Intrudes, and possibly comagmatic with, Torres Strait Volc. Three samples of granite dated at 295 m.y.
		Torres Strait Volcanics (Ct) Carboniferous?	DARU-MAER: Massive crystal-rich welded tuff; minor agglomerate, rhyolite, andesite, and interbedded sediments	Large xenoliths in Badu Gr

CENTRAL AND EASTERN HIGHLANDS (3)

Age	1M map unit	Constituent unit(s) in 1:250 000 Sheet areas	Thickness (m)	Lithology	Additional pertinent data
Quaternary	Qa^3	Qa, Qha Holocene		KARIMUI, MARKHAM, RAMU, SW MADANG, WABAG: Unconsolidated alluvial and swamp deposits: clay, sand, silt, gravel, minor peat, alluvial soil	In SW Madang, fluv sed. In places overlie Qs
		Qf, Qphf Holocene	80 in Ramu; 80+ in Markham	MARKHAM, E RAMU, NE KARIMUI, SW MADANG: Unconsolidated piedmont slope deposits: gravel, sand, silt, and clay. In Ramu, also boulder gravel with granite boulders. In Markham, generally stratified, poorly sorted, coarser in fan head than in toe	In Markham, fluv sed; surface sed Holo but probably Pleist below; lenticular sand and gravel aquifers with clayey gravel aquicludes. In Ramu and Karimui, may contain some fluvioglacial debris; in places veneered with Holo alluv
		Qs Quaternary (Partly included in Qv^3)		S RAMU, N KARIMUI: Talus, scree: rockfall debris mixed with soil beneath limestone cliffs; landslip and outwash rubble at base of steep slopes	Much of 1st talus recemented; large areas moved as debris-laden mudflows; extensively used as road constr gv
	Qv^3	Suaru, Karimui, Hagen Volcanics (Qvs, Qvk, Qvh) Quaternary		CENTRAL, NW KARIMUI: Basaltic (shoshonitic) to andesitic lava, agglomerate, tuff; minor derived sediments	All extinct. Hagen Volc derived from 3 major and at least 6 minor eruptive centres; extensive aprons and valley-fill material, mostly lahars; summit area of S-most centre glaciated; all major cones deeply eroded on NW side; hypabyssal intr
			apron to 150; cone crater to 2000	SW RAMU: Hagen Volcanics lava also dacitic and there are pyroclastics, lahar deposits, water-laid tuff derived from Hagen Volcano	

Qv^3 (contd)	Crater Mountain Volcanics (TQvc) Pliocene-Holocene		KARIMUI: Andesitic and basaltic lava; minor agglomerate, tuff, derived sediments	Deeply eroded volcano or volc complex with superimposed younger minor volc centres

Units not differentiated from Qv^3 on 1:1 000 000 map: In Karimui: Holo Ql (see Qs^3). In Ramu and Karimui: Quat Qs (see Qa^3)

Quaternary	Qs^3 Qhl Holocene (At least in part included in Qv^3)	c.100	NW MARKHAM: Bedded unconsolidated gravel sand, silt NE KARIMUI: Quartz-rich gravel W, SW RAMU: Peat present	Lake sed
	Qp Pleistocene	800	N RAMU: Mudstone, soft carbonaceous and shelly; interbedded with friable carbonaceous sandstone and siltstone; partly conglomeratic, grading laterally into chalky limestone	Marine sed. Overlain by fgl and alluv. Lst with corals, molluscs, bry
	Kainantu Beds (Qpn) Pleistocene	30-110	NW MARKHAM: Basal conglomerate overlain by succession of clay, silt, and sand, with some thin lenses of conglomerate; unconsolidated to poorly consolidated	Lake sed: tectonic activity formed two lakes which covered most of present up Ramu River. Age by C^{14} method from basal cgl probably 54 000 y. Source of Au from Kainantu area

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Late Miocene	Tmu Intrusives (Tmuy) 1 Miocene		SE RAMU: Monzonite, porphyritic microdiorite, quartz-feldspar andesite-porphyry, leucocratic quartz-biotite andesite-porphyry, hornblende andesite-porphyry	Irregularly shaped dykes and veins cutting Bismarck Intr Comp. K-Ar isotopic age about 7 m.y. Possible source of Cu and Au at Yanderra
	Benembi Diorite (Tmub) 1 Miocene?		SW RAMU: Porphyritic hornblende-quartz microdiorite	Age deduced from similarity to Michael Dr and Tmuy; possible source of Au at Kuta

Late Miocene	Tmu (contd)	Michael Diorite (Tmum) 1 Miocene	E KARIMUI: Porphyritic hornblende microdiorite	Large hypabyssal stock with parts of roof preserved. Strongly py; moderate late-stage hydrothermal alteration. Age by K-Ar method 7.3 ± 0.2 m.y.
		Elandora Porphyry (Tme) 1 Miocene	MARKHAM: Hornblende andesite-porphyry; subordinate porphyritic microdiorite; minor serpentinite; propylitization common	Isolated outcrops of microdr and serp in places assigned to Elandora Po. Intrudes Yaveufa Fm, Akuna Intr Comp, Omaura Gwke, Bena Bena Fm; probably intrudes Aifunka Volc. Age by K-Ar method 7.9 m.y. Py mineraliz common; prominent source of Au in Kainantu area; Mt Victoria mine on faulted contact with Mt Victoria Gd
Middle Miocene	Tmm	Oipo Intrusives (Tmi) m Miocene (At least partly included in Tmm in Region 1)	RAMU, SW BOGIA: Gabbro, granodiorite, tonalite, dolerite, diorite, pyroxenite, lamprophyre	Stocks and dykes. Intrude Wulamer Beds, Asai Sh. 15-17 m.y. old by K-Ar method. Textures range from fine-grained to pegmatitic; felsic stockworks and complex veining common. Py and pyrrh common; hbl more common than biot
		Bismarck Intrusive Complex (Tmb) m Miocene (At least in part included in JK^3)	SE RAMU: Hornblende gabbro, hornblende-biotite-quartz diorite; subordinate hornblende-pyroxene-biotite tonalite and granodiorite; minor mangerite, granite, aplite, muscovite, pegmatite, hornblendite, dunite, peridotite, and anorthosite	Smaller bodies SW of main batholith of less varied lithology. Bulk of rock 13 m.y. old from 50 samples dated by K-Ar and Rb-Sr method; pegmatite 9-10 m.y. old
			NE KARIMUI: Hornblende diorite, microgabbro	Rocks mainly fine-grained, darker and more po than those of main batholith in Ramu
			NW MARKHAM: Granodiorite, quartz diorite; minor tonalite, serpentinite; rocks sometimes porphyritic, but mainly equigranular	Main part of batholith 12.5 m.y. old as dated by K-Ar method. Intrudes Goroka Fm; contemp with Tmm

	Tmm (contd)			SW MADANG: Gabbro, diorite, dolerite, microdiorite, tonalite, pyroxenite, granodiorite	Intrudes Goroka Fm
		Kimil Diorite (Tmk) m Miocene		CENTRAL RAMU: Diorite, gabbro, tonalite, granodiorite, andesite-porphyry; dolerite and basalt dykes and veins; minor trachyandesite; fine to coarse and porphyritic varieties; alteration common	Dr commonly intruded by complex network of bs, dl, and gb dykes and veins. Some py. 15 m.y. old by K-Ar method. Size and distribution pattern similar to Oipo Intr; both possibly earliest cooled uppermost portions of batholithic bodies comagmatic with more deeply eroded Maramuni Dr and Bismarck Intr Comp
		Akuna Intrusive Complex (Tmak) e Miocene		MARKHAM: Olivine and hornblende gabbro, porphyritic dolerite, diorite; minor granodiorite, serpentinite	Intr Bena Bena Fm, Goroka Fm, and Omaura Gwke; intr by Elandora Po; unconf below Aifunka Volc. Age of dl, dr, and gd in Markham 14 to 16.5 m.y. by K-Ar method
Middle Miocene	At Mt Wilhelm and Mt Hagen, small glacial deposits of 10-20 m of unconsolidated moraine and fluvioglacial gravels (Qm) not distinguished from Tmm on 1:1 000 000 map				
	Tmm^3	Kenangi Gabbro (Tmke) m Miocene		NE KARIMUI: Hornblende gabbro, mangerite, granodiorite; commonly porphyritic and altered	Sills, dykes, and small stocks in Movi Beds and Yaveufa Fm; thermal aureoles up to 12 m wide; strong petrographic similarity to and very close spatial relat with lavas of Yaveufa Fm. Suitable as road gv
		Yaveufa Formation (Tma) m Miocene	2000-4800 in Karimui	NE KARIMUI: Coarse polymictic agglomerate and interbedded porphyritic andesite and basic lava; welded ash-flow tuff; volcanolithic sediments; waterlaid tuff, polymictic volcanic pebble, cobble, and boulder conglomerate, greywacke, and calcarenite S RAMU: Shoshonitic agglomerate	In Karimui and Ramu, volc and volcanolithic sed interf, former being dominant locally. In Karimui dated as 12.5 to 15 m.y. by K-Ar method

Middle Miocene	Tmm^3 (contd)			W. MARKHAM: Also subordinate tuff, greywacke, and minor reef limestone lenses	Unconf on Movi Beds, Aure Beds, and Omaura Gwke; intruded by Elandora Po; equiv to Langimar Beds (see Tmm^4 under Region 4)
		Aifunka Volcanics (Tmf) m Miocene		W MARKHAM: Andesitic lava, tuff, agglomerate	Unconf on Omaura Gwke and Akuna Intr Comp; intruded by probable Elandora Po. Major source of Au in Kainantu area
Oligocene-middle Miocene	To	Marum Basic Belt (Tmmb) Miocene? (At least in part included in		RAMU: Gabbro; minor norite, pyroxenite; anorthosite and gabbro pegmatite veins; dunite, commonly serpentinized	Banding common in main NW gb body
Early Miocene	$Tml-m^3$	Movi Beds (Tmo) e-m Miocene	500-4000 and thins to NW in Karimui; 500 in E Ramu	W MARKHAM: Well bedded volcanolithic and tuffaceous sandstone, shale, and siltstone, and polymictic pebble conglomerate	Unconf below Yaveufa Fm; later equiv of up part of Aure Beds. Abd foram
				E KARIMUI, S RAMU: Similar suite, but beds more calcareous, and coral limestone beds and lenses present	In E Karimui, well bedded shallow-water clastic sed with abd interbedded benth and plank foram, gast, biv, echino, and corals. In S Ramu, unconf on Chimbu Lst; strongly folded and faulted in Bismarck Fault Zone. Massive lenses have abd foram (1 Te to e Tf). Ripple marks, thin persistent lst beds, fine pebble lenses, and worm tracks

Units also included, at least partly, in $Tml-m^3$ on 1:1 000 000 map: In Karimui, Ramu: m Oligo-l Mio Aure Beds (see Tml^4 under Region 4)

Late Oligocene	Tou^3	Tou l Oligocene-e or m? Miocene	800	SW MADANG: Algal-foraminiferal biomicrite, siltstone, shale, greywacke; algal-foraminiferal biomicrite in lenses and highly fractured; bedding very irregular	Possible fringing reef complex. Unconf on Goroka Fm; paraconf on Teh. Dated by larger foram (Te, e Tf); algae and corals also present
		Omaura Greywacke (Tou) m-l Oligocene (At least in part included in JK^3,TT)		E KARIMUI: Shale and siltstone; cross-bedded feldspathic sandstone; schistose serpentinite	Lithologically similar to younger Movi Beds faulted against it; serp along Kami Fault. L Oligo age
				MARKHAM, WAU: See Tou^4 (under Region 4)	
		Nasananka Conglomerate (Ton) Oligocene	1500-2500, thins E and W	NW MARKHAM: Pebble and boulder conglomerate; subordinate arkose, greywacke, siltstone; conglomerate matrix commonly carbonaceous	Rapid vertical and lateral variations in lithology. Conf below Omaura Gwke; unconf on Bena Bena Fm; overlies Mt Victor Gd; calc breccias at base of Omaura Gwke may be later equiv. Detrital Au probably derived from Bena Bena Fm
Middle Eocene - early Oligocene	$Tem\text{-}ol^3$	Chimbu Limestone (Teoc) m Eocene-e Oligocene	300-1000	NW MARKHAM: Foraminiferal limestone, subordinate siltstone	Abd foram probably equiv in part to Teh limestone in Madang; probably unconf on Goroka Fm and Bena Bena Fm; possibly unconf below Omaura Gwke
			c.300 in Karimui	NE KARIMUI, S RAMU: Fine-grained algal limestone, nummulitic limestone, coarse calcarenite, and finer-grained foraminiferal limestone	Richly foss - some beds composed almost entirely of cemented foram; gast, biv, echino also abd
		Teh m-l Eocene (At least in part included in JK^3)		SW MADANG: Biocalcirudite, foraminiferal-algal biomicrite	Fringing reef comp? Unconf on Goroka Fm, but undiff from it locally; paraconf below Tou; equiv? to Chimbu Lst in Ramu, Karimui, and Markham

Late Palaeocene	Tau^3	Pima Sandstone (Tap) 1 Paleocene-Eocene	2000-3000?	CENTRAL KARIMUI: Thick-bedded fine to coarse feldspatholithic sandstone with small lenticular coquina beds, tuff, and rare conglomerate; mudstone and siltstone with laminations and thin interbeds of sandstone	Detritus from weathering of Kondaku Tuff and Chim Fm; mdst/sltst rich in carb material, rock frag, and clay minerals; sst clasts rare; fine laminations, ripple marks, small-scale cross-bedding in sst beds
Early - Late Cretaceous	Ku^3	Chim Formation (Kuc) Cenomanian-Maastrichtian	Av c.2000; max c.3000 in Karimui	N KARIMUI, SW RAMU: Massive finely laminated calcareous shale, some with fine-grained calcareous nodules and cone-in-cone structures; laminated sandstone, siltstone, shale with minor calcarenite and tuff beds; minor laminated tuff; altered volcanics, volcanolithic greywacke, calcarenite, conglomerate	Coarse-grained rock characterized by soft sed slump strucs mostly confined to up part of Fm; shallow-water dep indicated by small-scale cross-bedding, ripple marks, and well sorted sandy beds. Conf on Kondaku Tuff; unconf under Chimbu Lst. Mostly Cen-e Camp locally in Karimui; Cen-Tur with Camp-Maast in places in Ramu. Volc and volcanolithic rocks confined to Kundiawa area
		Mount Victor Granodiorite (Kuv) L Cretaceous (Included in Kl)		CENTRAL MARKHAM: Biotite-hornblende granodiorite	Exposed in core of Arau Anticline, SE of Kainantu. Possibly intrudes Bena Bena Fm; overlain by Nasananka Cgl. Dated as 90 m.y. by K-Ar method. Mt Victor Au mine on faulted contact of Mt Victor Gd and Elandora Po
		Intrusives (Kle) E Cretaceous? (At least in part included in Ju^3)	c.15 in Karimui	N KARIMUI: Pyroxene-hornblende diorite and microdiorite, mostly altered (especially chloritized) and veined with coarsely crystalline calcite W RAMU: Altered quartz-hornblende microdiorite, augite dolerite, gabbro	Intr Maril Sh in both Karimui and Ramu. In Karimui, sills in Maril Sh; age unknown; comp similar to that of volc rocks in overlying Kondaku Tuff, and apparent absence of these intr in rocks younger than L Jur suggests E Cret age. In W Ramu, may be corr of Kera Sill as intrudes Maril Sh, but age not known

Early - Late Cretaceous	Ku^3 (contd)	Kumbruf Volcanics (Klku) E Cretaceous?	1800 in Ramu	RAMU: Epidotized basaltic agglomerate and pillow lava, volcanolithic conglomerate, amygdaloidal lava; indurated calcareous siltstone and lithic and feldspathic sandstone	Conf below Asai Sh; underlying relat unclear - probably conf on Kompiai Fm; corr of Kondaku Tuff. Commonly altered
			6000 in Bogia	SW BOGIA: Massive indurated, strongly jointed basaltic to andesitic marine volcanic breccia, pillow lava, lava, volcanically derived greywacke, sandstone, and siltstone; subordinate tuff, agglomerate; metamorphosed in part; some sandstone tuffaceous	Dep on steep submarine slope and in deep, probably fault-bounded trough. Conf below Asai Sh. Contains plank and smaller benth foram
Early Cretaceous	Kl^3	Kondaku Tuff (Klk) Aptian-Albian	300-2450, thins towards Kubor Anticline	N KARIMUI, S RAMU: Coarse lithic sandstone, greywacke, tuffaceous sandstone, shale, siltstone; subordinate conglomerate, agglomerate, volcanic breccia, amygdaloidal lava	Sh and sltst most common but least prominent part of sequence; volc mostly confined to low part of fm. Dated by amm and biv; gast and blm also present; abd charred wood frag, some leaf impressions
Jurassic - Cretaceous	JK^3	Goroka Formation (Mg) Mesozoic, E Tertiary?		SW MADANG: Phyllite, slate, schist, carbonaceous siltstone, minor greywacke, quartzite; low-grade metamorphics of pelitic derivation, mostly quartz-veined; some metamorphosed intermediate dykes	Dep in deep trough and on steep submarine slope which received very fine terr detritus. Intruded by Bismarck Intr Comp; unconf below Teh, Tou; lithologically similar to Gusap Arg, which may be younger, high-level, less metam equiv; possibility of continuous dep of Goroka Fm through Gusap Arg, i.e. Goroka Fm may be E Tert in part
				NW MARKHAM: Also contains biotite-andalusite schist, carbonaceous schist; minor limestone, calcareous siltstone, andalusite hornfels	Possible corr of less metam units of Owen Stanley Metam; possibly less metam part of Bena Bena Fm; intruded by Bismarck Intr Comp

JK^3 (contd)			SE RAMU: In addition contains minor gneiss (commonly with lit-par-lit injections of Bismarck Intrusive Complex rocks), amphibolite, marble NE KARIMUI: Also contains massive quartzite and pyritic quartz-veined siltstone	Bedding well preserved with schistosity parallel to it. Age not known; may contain some E Tert metased; intruded by Bismarck Intr Comp
Jurassic - Cretaceous	Bena Bena Formation (Mb) Mesozoic	Probably several thousand in Markham; uncertain, minimum 450 in Karimui	NW MARKHAM, NE KARIMUI: Mainly low-grade metamorphics; actinolite-chlorite schist, quartz-sericite schist, mica schist (schists partly garnetiferous); minor knotted hornblende-feldspar gneiss, granitic gneiss; less metamorphosed phyllite, meta-greywacke, and meta-arkose	Possible corr of Owen Stanley Metam; base not exposed; unconf below Nasananka Cgl and Omaura Gwke; intruded by Karmantina Gneissic Gr, Akuna Intr Comp, and Elandora Po; possibly intr by Mt Victor Gd. In NW Karimui, two episodes of metam recognized

Units not differentiated, at least in part, from JK^3 on 1:1 000 000 map: In SW Madang: m Mio Bismarck Intr Comp (see Tmm); l Oligo Omaura Gwke (see Tou^3); and m-l Eo Teh (see $Tem\text{-}ol^3$)

Ju^3	Maril Shale (Jum) Kimmeridgian	400-2000	RAMU, N KARIMUI: Moderately indurated shale and siltstone with variable carbonate and mica content; commonly pyritic, especially more carbonaceous beds; subordinate fine to medium sandstone, calcilutite, and shale; basal unit of arkose, silicified and calcareous shale/slate breccia and conglomerate. See also under Region 1	In Karimui, unconf below Chimbu Lst; py common as beds, nodules, and dissem. In Ramu, massive or well bedded; basal unit in Kubor Anticline only; elsewhere conf on Balimbu Gwke or Mongum Volc; dated by biv in up part
Late Jurassic				

Unit not differentiated, at least in part, from Ju^3 on 1:1 000 000 map: In Karimui and Ramu: E Cret? intr (see Ku^3)

Early - Middle Jurassic	J1-m^3	Karmantina Gneissic Granite (Mjk) M Jurassic (Included in J1)		NW MARKHAM: Biotite-muscovite gneissic granite	Intrudes Bena Bena Fm. Dated at 172 m.y. by Rb-Sr method, but possibly emplaced in Trias
		Mongum Volcanics (Jmm) M Jurassic?	250	S CENTRAL RAMU: Basaltic agglomerate and pillow lava interbedded with pebble and cobble conglomerate and feldspathic greywacke; basalt	Age inferred from conf strat position between E Jur Balimbu Gwke and Jur Maril Sh
		Balimbu Greywacke (J1b) Sinemurian-Pliensbachian	280-2000	S CENTRAL, NW RAMU: Calcareous and volcanolithic greywacke and interbedded siltstone; fine sandstone and siltstone; minor shale	Conf below Maril Sh and Mongum Volc; unconf on Kana Volc - probably partly derived by reworking of Kana Volc; well indurated resistant sst beds rhythmically interbedded with recessive sltst and sh. Amm, blm, biv, and brach poorly preserved; dated by amm
Early Jurassic	J1	J1u (unnamed intrusive) E Jurassic?		SE RAMU, NE KARIMUI: Deeply weathered granodiorite and diorite with aplite and dolerite dykes	Unconf below Chimbu Lst. Dated as 180-190 m.y. by Rb-Sr method
	Unit also included in J1 on 1:1 000 000 map: In Markham: M Jur Karmantina Gneissic Gr (see J1-m^3)				
Permian-Triassic	PuR1^3	Kuta Formation (PRk) 1 Norian-Rhaetian	100-250	N KARIMUI, SW RAMU: Limestone, sandy limestone, minor arkose in lower part	Contains mixed fauna of brach, biv, amm, corals, foram, and conodonts
Late Triassic	Ru^3	Kana Volcanics (Ruk) Carnian-Norian	200-3500	CENTRAL, NW, SW RAMU, N KARIMUI: Massive basic to intermediate agglomerate, basalt lava, dykes; tuff and conglomerate, acid? lava, fine volcanic breccia (lapilli? tuff); pillow lava; greywacke; recrystallized coral lime-	Mostly marine but some subaerial lavas and pyroclastics. In Ramu extensively intruded by Mio plutonic and hypabyssal rocks and unconf overlain by Balimbu Gwke or younger fms; biv in headwaters of Jimi R

Late Triassic	Ru^3 (contd)		stone, calcarenite; volcanolithic and feldspathic sandstone; extensively epidotized and recrystallized to low greenschist facies; lavas mainly andesitic, but some basalt, dacite, rhyolite	
	Jimi Greywacke (Ruj) Carnian-Norian	800+, base not seen	RAMU: Highly indurated fine to medium greywacke and siltstone; commonly micaceous and calcareous; coarse beds generally carbonaceous; minor shale, siltstone, feldspathic sandstone	Grades upwards through trans zone into Kana Volc. Dated by amm; also contains biv, gast, brach
Late Permian	Pu Kubor Granodiorite (Puk) L Permian		N-CENTRAL KARIMUI, SW RAMU: Coarse biotite-hornblende granodiorite and tonalite commonly altered and deeply weathered; small stocks and dykes of diorite and gabbro; dykes and veins of aplite and muscovite pegmatite	In core of Kubor Anticline; probably contains unmapped roof pendants of Omung Metam. Sulphide minerals (mainly py) very sparse. Dated as 244 m.y. by Rb-Sr method
Carboniferous?-Permian	Pz^3 Omung Metamorphics (Pzo) L Palaeozoic	2000+	N-CENTRAL KARIMUI, S RAMU: Slate, phyllite, sericite schist, and partly recrystallized indurated siltstone and shale; less common metagreywacke, basic metavolcanics, spotted slate, hornfels; quartz veins and pods. In Karimui low-grade low-pressure metamorphics, hornfels	In Karimui, slaty cleavage only in fine-grained rocks; contains numerous small unmapped Kubor Gd bodies; age unknown, but older than up Kubor Gd. In Ramu, metagwke and slightly metam sh and sltst have blocky jointing, poorly dev cleavage, some graded and fine current-bedding, and interformational brec; slaty cleavage only in finer-grained rocks and commonly parallels bedding; secondary strain-slip cleavage and resultant small folds and crenulation lineations on main cleavage surfaces present locally; in places tightly folded beds have axial-plane cleavage; post-metam chevron folds and kink bands in phyllite

PAPUAN GULF AND PENINSULA (4)

Age	1M map unit	Constituent unit(s) in 1:250 000 Sheet areas	Thickness (m)	Lithology	Additional pertinent data
Quaternary	Qa^4	Qhc, Qs Pleistocene-Holocene (At least in part included in Tmm-p^4)	100	PORT MORESBY-KALO-AROA, N YULE: Colluvium: angular rock fragments in clay matrix, unsorted, unconsolidated; includes some alluvium	Steeply-dipping chaotic scree dep and talus cones; peripheral to cliff-bounded volc plateau remnants where talus cones coalesce to form debris apron
		Qa, Qa_1, Qha Pleistocene, Holocene	to 500	YULE, PORT MORESBY-KALO-AROA, SW HUON-SAG SAG, SAMARAI, ABAU, SALAMAUA, TUFI-CAPE NELSON, SE MARKHAM, S WAU: Alluvium, littoral and beach deposits: gravel, sand, silt, carbonaceous mud, clay; some swamps and organic remains locally. Older alluvium includes poorly consolidated conglomerate, sandstone, siltstone, shale. Raised coral reef in Port Moresby-Kalo-Aroa	In Samarai, Salamaua, and Abau, coastal plains and river valleys. Unconf on Kuta Volc and East Cape Gb in Samarai. In Tufi-Cape Nelson, contains some alluv Au locally. In Markham, alluv Au still worked in river gv. In Yule and Port Moresby-Kalo-Aroa, dep currently accumulating; locally contain mt but not in economic quantities; locally gv from river courses used as road agg
		Qt Pleistocene, Holocene (At least in part included in Tmm^4)	60	YULE: Alluvial terraces: unconsolidated deposits of boulders and rounded cobbles admixed with gravel and sand; predominantly volcanic material	Fluv dep derived from reworked scree form elongate gravel banks which coalesce to form terraces
		Qpc Pleistocene (At least in part included in Tmm^4)	6	YULE: Raised reef: cavernous coralgal reef limestone with large solitary corals apparently in position of growth; raised reef and chaotic reef talus	Remnants of former fringing reef complex. Unconf on Chiria Fm. Reefal fauna of corals, algae, bry, biv, gast
		Qp Pleistocene?-Holocene (At least partly included in Tmm^4)		WAU: Coarse unsorted angular conglomerate; unconsolidated gravel, sand, and silt in uplifted flood plains	Cgl torrentially dep near Wau; fluv sed

Qa^4 (contd)	Ubo and Wakioki Fanglomerates (Qhu, Qhx) Holocene	50	E TUFI-CAPE NELSON: Gravel, sand, silty clay with scattered large subangular boulders	
	Kwagira Beds, Agaun Conglomerate, and Silimidi Conglomerate (Qpk, Qpa, Qps) Pleistocene (At least in part included in Tp^4)	100-500	TUFI-CAPE NELSON: Conglomerate, poorly sorted sandstone, siltstone; marl locally	Kwagira Beds mostly non-marine; no age evidence; lap on to Tapio Marl. Agaun Cgl raised former alluv; overlies Goropu Metabs and Yau Gb with angular unconf. Silimidi Cgl also raised former alluv; overlies Domara R Cgl with angular unconf; interf with Sivai Brec Mem, Ibau Brec; no definite age evidence; tilted but not folded

Units not differentiated, at least in part, from Qa^4 on 1:1 000 000 map: In Port Moresby-Kalo-Aroa: l Mio-e Plio Yaifa Fm, Kupiano Beds, and Siro Cgl (see $Tmm\text{-}p^4$); and e-m Mio Kido Lst (see Tmm^4)

Quaternary	Qv^4 Sivai Breccia Member (of Silimidi Conglomerate) (Qpv) Pleistocene (At least in part included in Qs^4, TT)	Individual sheets 10-20	TUFI-CAPE NELSON: Ultramafic breccia; peridotite clasts in matrix of finer peridotite grains*	Origin probably colluvial or volc (i.e., fluidized by volc gasses). Sheets interbedded with Silimidi Cgl; pipes reportedly intrude Tectonite ultram. No definite evidence of age. Erosion surfaces probably too young to permit dev of Ni residual soils
	Manna Volcanics (Qm) Pleistocene-Holocene	750	NW TUFI-CAPE NELSON, NE PORT MORESBY-KALO-AROA: Rhyodacitic and rhyolitic ash and lava; much ash-flow deposits	In Tufi-Cape Nelson, small volc cones and tholoids; larger dissected ash cones; interf with Uoivi Volc; overlaps Sesara Volc and Lokanu Volc; some ash layers dated at 10 000 and 80 000 years by K-Ar method. In Port Moresby-Kalo-Aroa, small linear volc complex of similar age; interf with Uoivi Volc; partly overlie Lokanu Volc, Cumulate gb, Sesara Volc, Managalase Volcanics, and Hydrographers Range Volc

Qv^4 (contd)	Qpg Pleistocene (At least partly included in TT)	to 300	NE PORT MORESBY-KALO-AROA: Andesitic ash	Distal ash dep, possibly related to Hydrographers Ra Volc; interf with Managalase Volc; unconf on Tectonite ultram, Cumulate ultram, Cumulate gb, and Granular gb
	Managalase Volcanics (Qpma) Pleistocene	500	NE PORT MORESBY-KALO-AROA: Andesitic ash; minor agglomerate and some mud flows	Distal apron of finer pyroclastics and volc derived sed, possibly assoc with stratovolcano of Hydrographers Ra Volc. Age from degree of dissection, and possibly from relat with Hydrographers Ra Volc. Unconf on Tectonite ultram, Cumulate ultram, Granular gb, and Sesara Volcanics
	Qpu Pleistocene		NE PORT MORESBY-KALO-AROA: Andesitic and basaltic volcanics, including lava; little known	Small volc complex; possibly related to other Pleist volc. Unconf on Tectonite ultram, Cumulate ultram, Granular gb, and KTk
Quaternary	Efogi Volcanics (Qpe) Pleistocene (At least partly included in JK^4)	60	PORT MORESBY-KALO-AROA: Porphyritic basaltic to andesitic lava; shoshonitic affinities*	Local volc activity, probably related to fracturing as result of regional uplift; mostly valley-fill dep. Unconf on Kagi Metam. Age estimated from degree of dissection
	Qpa Pleistocene (At least partly included in Tou^4)	to 50	S MARKHAM: Tuffaceous and calcareous sand and gravel; acid and intermediate volcanic components derived from Mt Yelia	Lake dep; lake formed by volc activity of Mt Yelia. Plant remains
	Qhw, Qvy Pleistocene-Holocene		WAU, S MARKHAM: Dacitic lava, agglomerate, crystal tuff; locally andesitic lava, obsidian	Qhw derived from Koranga volcano near Wau; volcano still retains crater form. Qvy derived from recent volc activity at Mt Yelia
	Waiowa Volcanics (Qhw) Holocene	25	CENTRAL TUFI-CAPE NELSON: Andesitic ash and unconsolidated agglomerate	Products of Waiowa volcano erupted in 1943-4

Qv^4 (contd)	Victory Volcanics (Qv) Pleistocene-Holocene	2500	TUFI-CAPE NELSON: Andesite, basaltic andesite; minor basaltic and dacitic flows; agglomerate; unconsolidated pyroclastics	Stratovolcano with breached central vent and small subsidiary eruptive centres
	Sesagara Volcanics (Qz) . Pleistocene-Holocene	to 300	TUFI-CAPE NELSON: Mainly andesitic pyroclastics	
	Uoivi Volcanics (Qu) Pleistocene-Holocene	600	NE PORT MORESBY-KALO-AROA, NW TUFI-CAPE NELSON: Basaltic and andesitic lava flows with shoshonitic affinities*	In Port Moresby-Kalo-Aroa, lava flows, flow domes, scoria mounds, cinder cones, and explosion craters in places; volc cluster; interf with Manna Volc; partly overlies Lokanu Volc, Sesara Volc, Hydrographers Ra Volc, Managalase Volc; K-Ar dates range from 0.08-0.35 m.y. In Tufi-Cape Nelson, overlaps Sesara Volc and Lokanu Volc
Quaternary	Hydrographers Range Volcanics (Qph) Pleistocene (At least in part included in Qpu^4)	to 2500	NW TUFI-CAPE NELSON, PORT MORESBY-KALO-AROA: Basalt, andesitic and dacitic agglomerate, ash and lava	Dissected stratovolcano. Unconf on Lokanu Volc and Tectonite ultram; underlies Mt Lamington Volc, Uoivi Volc, and Manna Volc. Dated as 0.67-1.45 m.y. by K-Ar method
Qpv^4	Mount Lamington Volcanics (Ql) Pleistocene-Holocene	200	PORT MORESBY-KALO-AROA: Andesitic ash and agglomerate*	Outer ash slopes of Mt Lamington volcano. In fault contact with and probably overlies Tectonite ultram; overlies Hydrographers Ra Volc. Age up to 0.09 ± 0.01 m.y. by C^{14} method
	Cape Nelson Volcanics (Qpn) Pleistocene	to 2500	TUFI-CAPE NELSON: Andesite, basaltic andesite; minor basalt and dacite flows, agglomerate, unconsolidated pyroclastics	Dissected volcano. Age estimated from degree of dissection. Lapped on by Victory Volc on Cape Nelson pen

Unit not differentiated, at least in part, from Qpv^4 on 1:1 000 000 map: In Port Moresby-Kalo-Aroa and Tufi-Cape Nelson: Pleist Hydrographers Ra Volc (see Qv^4)

Qs^4	Qs Pleistocene-Holocene	to 100	S TUFI-CAPE NELSON, SALAMAUA: Colluvium: chaotic deposits of angular rock fragments in fine matrix; some alluvium	Landslide and creep dep
	Qc Quaternary	to 50	TUFI-CAPE NELSON, SAMARAI: Raised coral reef	In Tufi-Cape Nelson, source of lime. In Samarai, unconf on Kutu Volc and East Cape Gb
Quaternary	Ibau Breccia (Qpi) Pleistocene (At least in part included in Tp^4, π)	to 150	TUFI-CAPE NELSON: Ultramafic breccia of peridotite clasts in finer matrix; thick chaotic deposits	Origin probably colluvial. Might be later equiv of Sivai Brec Mem; overlies Tectonite ultram, Goropu Metabs, and probably Domara R Cgl and Silimidi Cgl. Erosion surfaces probably too young to permit dev of Ni residual soils
	Ararabu Conglomerate (Qpar) Pleistocene (At least in part included in To)	80	PORT MORESBY-KALO-AROA: Poorly consolidated conglomerate, sandstone, and siltstone	Lake and alluv sed dep in small tectonically controlled basins. Unconf on Bomuguina Beds, Sadowa Gb, Gidobada Lst, Kwikila Aglm, and Kupiano Beds. No definite age evidence except for strat relat and poor consolidation. Used for road-making agg

Units not differentiated, at least in part, from Qs^4 on 1:1 000 000 map: In Tufi-Cape Nelson: Pleist Sivai Brec Mem (see Qv^4); and Plio Cloudy Bay Volc (see Tp^4). In Port Moresby-Kalo-Aroa: Eo Bomuguina Beds (see Te^4)

Pliocene-Quaternary	TpQp	Edie Porphyry (Tpp, Tpc) Pliocene (At least in part included in JK^4)	E WAU, SE MARKHAM: Biotite and hornblende andesite and dacite, porphyry stocks and dykes, many hydrothermally altered*	Several phases of po intr; main intr antedates Bulolo Aglm. Dated by K-Ar method as 3.5 m.y.; many intr probably younger and possibly main Au mineralizers; isolated K-Ar dating of 2.5 m.y. from one of younger po. Intrudes Owen Stanley Metam; frag constitute large part of Bulolo Aglm and Namie Brec

Pliocene-Quaternary	TpQp (contd)	Bonua Porphyry (Tpb) Pliocene	S TUFI-CAPE NELSON: Microdiorite and micro-monzonite porphyry stocks and related lamprophyre dykes*	Dykes within ultram rocks. Possibly related to volc of Domara R Cgl and its Musa Volc Mem. Age based on K-Ar date of 5.3 ± 0.2 m.y. (biotite). Possible source of Au and Cu and possible agent in Ni sulphide mineraliz
	Tp^4	Kwinimaga Sandstone (Tpk) Pliocene?	200	TUFI-CAPE NELSON: Sandstone, conglomerate, siltstone, claystone	Cyclic dep, possibly marginal marine. Overlies Ruaba Sst with angular unconf; possible later equiv of Awaitapu Clst. Undatable plant fossils
		Domara River Conglomerate (Tpd) Pliocene	1500	TUFI-CAPE NELSON, E PORT MORESBY-KALO-AROA: Polymictic conglomerate, sandstone, siltstone, mudstone; moderately consolidated; some agglomerate and lava*	In Tufi-Cape Nelson, entirely non-marine or possibly with minor shallow marine intcal; dep in intermontane basin during uplift of Tectonite ultram, Granular gb, Lokanu Volc, Kutu Volc, etc; age tentatively based on K-Ar date of related? dyke of Bonua Po (5.3 ± 0.2 m.y., biot), and of volc clast (2.36 ± 0.05 m.y., whole rock). In Port Moresby-Kalo-Aroa, unconf on Papuan Ultram Belt, Kagi Metam, Emo Metam, Kemp Welch Beds, and Kutu Volc; contains gast, some biv, and carb wood
Pliocene		Musa Volcanic Member (of Domara River Conglomerate) (Tpz) Pliocene	130	E PORT MORESBY-KALO-AROA, W TUFI-CAPE NELSON: Basaltic agglomerate with shoshonitic affinities*	Remnants of volc cone(s). Interbedded with basal portion of Domara R Cgl. In Tufi-Cape Nelson, unconf on Tectonite ultram, Granular gb, and Lokanu Volc
		Apinaipi Formation (Tpn) Pliocene	200	See $Tmm\text{-}p^4$ (Port Moresby-Kalo-Aroa)	

Tp^4 (contd)	Cloudy Bay Volcanics (Tpc, Tpt) Pliocene (At least partly included in Qs^4)	200-300	SW TUFI-CAPE NELSON, NW ABAU, SE PORT MORESBY-KALO-AROA: Basaltic and andesitic pyroclastics and lava; porphyritic, vesicular; shoshonitic affinities* Tpt: also tuff and tuffaceous sandstone (little known) in Port Moresby-Kalo-Aroa	In Tufi-Cape Nelson, facies equiv? of Domara R Cgl and its member; unconf on Kutu Volc. In Abau, probably unconf on Juliade Lst and Kutu Volc. In Port Moresby-Kalo-Aroa, unconf on Kutu Volc; tentatively corr with Tpy, Kwikila Aglm, Astrolabe Aglm, and Mt Davidson Volc. Tpt unconf on Kutu Volc and Bomuguina Beds; probably related to Cloudy Bay Volc
	Awaitapu Claystone (Tpw) Pliocene	350	TUFI-CAPE NELSON: Claystone, laminated marl; some sandstone, siltstone, conglomerate	Overlies Ruaba Sst with angular unconf. Age of N outcrop from microfoss; age of SW outcrop inferred
	Gwoira Conglomerate (Tpr) Pliocene	1000	E TUFI-CAPE NELSON: Poorly sorted conglomerate; sandstone, siltstone	Dep in high-energy envir during rapid uplift of Kutu Volc; N margin subsequently uplifted. Unconf on Goropu Metabs and Tectonite ultram
Pliocene	Tpa, Uga Sandstone, and Mailu Sandstone (Tpu, Tpl) Pliocene	to 500	NW, NE ABAU, SAMARAI, SE TUFI-CAPE NELSON: Poorly consolidated sandstone, siltstone, conglomerate	In Abau, fluv sed raised, tilted, and folded; unconf on Juliade Lst. In Samarai, Abau, and Tufi-Cape Nelson, fluv and shallow marine? sed unconf on Kutu Volc
	Fife Bay Volcanics and Mount Suau Member (Tpf, Tpfs) Pliocene	500; member 300 in Samarai	SE ABAU, SAMARAI: Basaltic and andesitic lava, agglomerate, and tuff; some pillow lava; minor tuffaceous sedimentary rocks; many dykes*. 200 m of 'welded' basaltic agglomerate (Tpfs) in Samarai only	In Abau, unconf on Badila Beds. In Samarai unconf on Kutu Volc, Badila Beds, Modewa R Beds; member unconf on Kutu Volc, Modewa R Beds; may be basal part of Fife Bay Volc
	Tmi 1 Miocene-1 Pliocene	300	SE YULE: Calcareous and non-calcareous siltstone; minor mudstone and tuffaceous sandstone	Closer to source of sed than Miaru Mdst; only known equiv of Miaru Mdst in Ovoi area; conf on Lavao Fm; conf below Apinaipi Fm
	Babwaf Conglomerate (Tpb) Pliocene	1300+	S MARKHAM: Massive pebble and cobble conglomerate; subordinate coarse micaceous sandstone and siltstone; well sorted, poorly indurated	Shallow-water sed in partly faulted syncline; last phase of sedimentation in Aure Trough. Unconf on Langimar Beds, Omaura Gwke, and Owen Stanley Metam. Contains plant remains and Mio and Plio foram. Regarded as Plio on field

Tp^4 (contd)			WAU: Thickly bedded polymictic conglomerate and minor interbedded lithic sandstone, silty calcareous mudstone, and brecciated conglomeratic coral limestone	relat and similarity to Leron Fm. In Wau, contains Mio-Plio foram
	Leron Formation (Tpl) Pliocene		E MARKHAM: See Tp^6 (under Region 6)	
	Tp Pliocene	650-1600	S WAU: In E, poorly consolidated conglomerate, sandstone, mudstone, tuffaceous sandstone, and interbedded dacite and andesite pyroclastics; in W, sandstone, siltstone, and mudstone, commonly calcareous or carbonaceous; pebble conglomerate and coral limestone concretions	Conf on 1 Mio (Tg stage) rocks; overlaps onto Owen Stanley Metam. Abd foram; barren top of unit might be Pleist
Pliocene	Otibanda Formation (Tpo) Pliocene	to 765	NE WAU: Poorly consolidated tuffaceous siltstone, sandstone, conglomerate, tuff	Lake and fluv envir. Unconf on Edie Po, Bulolo Aglm, Owen Stanley Metam. Contains vertebrate foss. 3.5 m.y. old by K-Ar method on biot, hbl, plag
	Bulolo Agglomerate (Tpg) Pliocene	300+	NW WAU: Massive dacitic and andesitic agglomerate with minor tuff bands; rare obsidian flows	Unconf on Morobe Gd. Derived from several centres of eruption; 3.5 m.y. old by K-Ar determination on biot, hbl, plag
	Namie Breccia (Tpv) Pliocene		NE WAU: Volcanic breccia of angular fragments of schist and dacitic and andesitic porphyry in fine-grained hydrothermally altered matrix; vague banding and some tuff beds discernible in upper parts	Pipes probably diatremes, up to 1 km across, intruding Owen Stanley Metam. Erupted at about same time as Bulolo Aglm. Host rock for some Au; contains veins and stringers of manganocalcite, rhodocrosite, qtz, auriferous py, sphalerite, marmatite, galena, free Au; sulphides also dissem

Tp^4 (contd)	Sesara Volcanics (Tps) 1 Miocene-e Pliocene	550	NE PORT MORESBY-KALO-AROA, NW TUFI-CAPE NELSON: Basaltic agglomerate, lava, tuff; shoshonitic affinities; minor volcanic sandstone*	Remnants of large central volcano. Unconf on Lokanu Volc, Granular gb, High-level gb; overlain by Qpma, Manna Volc, Uoivi Volc. Dated by K-Ar method as 5.4-5.7 m.y.
Pliocene	Units not differentiated, at least in part, from Tp^4 on 1:1 000 000 map: In Tufi-Cape Nelson: Pleist Ibau Brec (see Qs^4); and Pleist Kwagira Beds, Agaun Cgl, and Silimidi Cgl (see Qa^4). In Abau: l Oligo?-m Mio Magavara Syenite (see Tmm). In Port Moresby-Kalo-Aroa: Eo Bomuguina Beds (see Te^4). In Huon-Sag Sag and E Markham: Plio Leron Fm (see Tp^6)			
$Tmm-p^4$	Apinaipi Formation (Tpn, Tpn_1) Pliocene (At least in part included in Tmu^4)	2000 in Yule; 200 in Port Moresby-Kalo-Aroa	PORT MORESBY-KALO-AROA, YULE: Immature calcareous tuffaceous sandstone, pebble and cobble conglomerate, siltstone, mudstone; minor reefal limestone, volcanic agglomerate, tuff, brecciated lava*	Dep during period of rapid uplift and renewed volc; rapid facies variations from fluv to deltaic to littoral to shallow-water marine envir. In Yule, locally unconf flanks Lavao Fm; conf on Miaru Mdst; interf with and conf on Wedge Hill Lst; to E largely derived from and partly overlies contemp Mt Davidson Volc; poorly preserved foram, algae, bry; many plant remains, silicified wood, frag biv and gast; shallow-water marine and brackish-water Plio assem identified; post-Tg; cgl used as road agg. In Port Moresby-Kalo-Aroa, unconf on Lavao Fm
Late Miocene - Pliocene	Tpy Pliocene	150	PORT MORESBY-KALO-AROA: Basaltic and andesitic pyroclastics; minor lava	Subaerial dep of volc. Tentatively corr with Mt Davidson Volc and Astrolabe Aglm; unconf on Kagi Metam, Kemp Welch Beds, Port Moresby Beds, Kutu Volc, Sadowa Gb
	Wedge Hill Limestone (Tpw) Pliocene	350	COASTAL YULE: Coralgal limestone, calcareous sandstone, pebble conglomerate; minor calcareous mudstone and siltstone; mudstone interbedded with resistant limestone at base; reef-derived sediments	Linear reef complex on rising anticlines forming tectonic islands; reefs initially flanked by own debris, but generally dev of lst inhibited by rapid encroachment of Apinaipi Fm sed. Conf on Miaru Mdst; conf below and interf with Apinaipi Fm; deeper-water mdst (Miaru Mdst) grades up into calc mdst overlain by shallow-water calc facies (Wedge Hill Lst); molluscs, echino spines, bry, reef-assoc larger benth foram. Used as road agg

	$Tmm\text{-}p^4$ (contd)	Kwikila Agglomerate (Tpk) Pliocene	80	PORT MORESBY-KALO-AROA: Basaltic and andesitic agglomerate; minor interbedded tuff; tuffaceous sandstone and volcanic conglomerate confined to base of unit*	Subaerial dep of frag volc close to volc centre. Tentatively corr with Mt Davidson Volc and Astrolabe Aglm; unconf on Sadowa Gb and Gidobada Lst. Aglm potential source of agg
		Astrolabe Agglomerate (Tpa) Pliocene	300	PORT MORESBY-KALO-AROA: Basaltic and minor andesitic laharic agglomerate and tuff with interbeds of volcanically derived conglomerate and sandstone*	Dep of nuee ardente-type and airfall pyroclastics and also reworked volc in form of avalanches, lahars, and volc derived sed in shallow lakes in tectonically controlled depression. Volc centre unknown. Up part of Mt Cameron volc comp (m Mio to Plio). Unconf on Kagi Metam, Kemp Welch Beds, Port Moresby Beds, Sadowa Gb; conf on Siro Cgl; probably corr of Mt Davidson Volc. Coniferous wood, casts of tree logs and trunks. Exploration for bx not successful; matrix-poor aglm used for concrete agg for local hydroelectric scheme
Late Miocene - Pliocene	Mount Cameron volcanic complex	Mount Davidson Volcanics (Tpda) Pliocene	600 in Yule; to 600 in Port Moresby-Kalo-Aroa	YULE, NW PORT MORESBY-KALO-AROA: Basaltic and minor andesitic agglomerate, tuff, lava, lava breccia, with intercalated volcanically derived coarse conglomerate and sandstone increasing	In Yule, subaerial volc - pyroclastics and lava brec with intcal laharic and fluv sed; eruptive centres not identified; paraconf on Yaifa Fm; grades later into and partly overlain by derived contemp Apinaipi Fm; no dating from foss, but adjacent, probably contemp Apinaipi Fm contains Plio foram and overlies Tg stage mdst. In Port Moresby-Kalo-Aroa, unconf on Kagi Metam, Kemp Welch Beds, Port Moresby Beds?; conf on Yaifa Fm; age from contemp Apinaipi Fm
		Yaifa Formation (Tmy) l Miocene-e Pliocene (At least in part included in Qa^4)	300 in Yule; to 100 in Port Moresby-Kalo-Aroa	SE YULE, PORT MORESBY-KALO-AROA: Massive, tuffaceous sandstone with pebble horizons which grade through paraconglomerate into massive cobble conglomerate with tuffaceous sandstone matrix; lenses of soft siltstone, mudstone, and claystone*	In Yule, fluv and lake sed derived from and dep over Talama Volc and accumulated locally during period of volc quiescence; possibly shallow-marine in part in core of Kurai Anticline. Age based on probable equiv to Miaru Mdst; paraconf on Talama Volc; paraconf below

Tmm-p^4 (contd)				Mt Davidson Volc; to W probably grades into Miaru Mdst; intruded by Tmi. In Port Moresby-Kalo-Aroa, overlain by Mt Davidson Volc; probable corr of Siro Cgl
Late Miocene - Pliocene	Mount Cameron volcanic complex	Siro Conglomerate (Tms) l Miocene-e Pliocene (At least in part included in Qa^4, To)	60	W PORT MORESBY-KALO-AROA: Polymictic orthoconglomerate, sandstone, siltstone, mudstone; moderately consolidated*	Fluv and lake dep. Unconf on Port Moresby Beds, Kemp Welch Beds?, and Sadowa Gb; conf below Astrolabe Aglm; tentatively corr with Yaifa Fm. Contains non-marine gast. Age from tentative corr with Yaifa Fm
		Talama Volcanics (Tmt) m-l Miocene (At least partly included in JK^4)	1500	E YULE: Andesitic and basaltic agglomerate, tuff, lava breccia, lava, and interbeds of derived conglomerate, sandstone, and minor mudstone*	Subaerial volc in which pyroclastics predominated over lava flows; penecontemp erosion resulted in intcal laharic and fluv derived sed. Unconf on Kagi Metam, Auga Beds, Aibala Volc; disconf on Tmx to E, and probably conf on Tmx to W; to W, probably grades later into Chiria Fm and Lavao Fm; paraconf below Yaifa Fm, Mt Davidson Volc; conf below Miaru Mdst; intruded by Tmi. At one place calc tuffaceous sst at base contains e Tf larger benth foram; possible corr with Chiria and Lavao Fm suggests partly m-l Mio age
		Kupiano Beds (Tpku) l Miocene-e Pliocene (At least in part included in Qa^4)	to 200	PORT MORESBY-KALO-AROA: Sandstone, shelly sandstone, siltstone, mudstone, limestone; minor conglomerate	Dep in shallow-water marine envir. Unconf on Port Moresby Beds and Bomuguina Beds; unconf below Ararabu Cgl. Dated by larger benth foram; gast, corals, biv also present; some fine-grained rocks contain plank foram and opaline and qtz spicules, and tests of sponges and other micro-organisms. Used as constr material, particularly road-making agg

Tmm-p^4 (contd)	Miaru Mudstone (Tmu, Tmn) 1 Miocene-e Pliocene (Included in Tmu^4)	1800 (Tmu); 300 (Tmn)	COASTAL YULE: Tmu: Soft, finely bedded mudstone, shale; minor thin interbeds of siltstone, sandstone, limestone, and conglomerate; in places volcanic interbeds towards base; local conglomerate. Tmn: Calcareous and non-calcareous siltstone, minor mudstone, and tuffaceous sandstone	Tmu: Overlain and underlain by shallow-water marine sed; in far NW, conf on Aure Beds; elsewhere, on Talama Volc and probably Lavao Fm; probably contemp with fluv Yaifa Fm; in coastal anticline, conf below Wedge Hill Lst and elsewhere below Apinaipi Fm; contains abd pelagic foram of Tg stage; shallow-water benthonic foram at intervals. Tmn: Local equiv of Miaru Mdst; conf on Lavao Fm; conf below Apinaipi Fm; closer to source of sed than Miaru Mdst
Late Miocene - Pliocene	Ruaba Sandstone (Tmr) m Miocene-Pliocene	3500	TUFI-CAPE NELSON: Lithic sandstone, polymictic conglomerate, siltstone; some silty claystone and tuff	On Cape Vogel Pen, unconf below Awaitapu Clst. Some plant remains. Maximum age based on e Tf foram. Reported petrol gas and oil shows in three shallow wells drilled in 1927-8

Units not differentiated, at least in part, from Tmm-p^4 on 1:1 000 000 map: In Port Moresby-Kalo-Aroa: Pleist-Holo Qs (see Qa^4). In Yule: Pleist-Holo Qhc (see Qa^4); and Jur?-Cret Kagi Metam and L Cret-Eo Auga Beds (see JK^4). In Tufi-Cape Nelson: l Mio Tapio Marl (see Tmu^4)

Late Miocene	Tmu^4	Tmu 1 Miocene	400-2000	S, SW WAU: Marl, mudstone, and siltstone, with interbeds of argillaceous sandstone, pebble conglomerate, and coral and algal limestone towards base; conglomerate predominates to E	Unconf on m Mio shelf and trough facies. Abd Tg foram in mdst; basal beds probably l Tf
		Oveia Diorite (Tmo) 1 Miocene? (Partly at least included in JK^4)		N PORT MORESBY-KALO-AROA: Diorite, monzonite	Partly unroofed stock, probably related to Mio and Plio volc. Intrudes Kagi Metam and Emo Metam; minor py mineraliz on joint surfaces
		Tapio Marl (Tmt) 1 Miocene (Included in Tmm-p^4)	60	TUFI-CAPE NELSON: Marl and shale with interbedded limestone and thin lenses of sandstone and conglomerate	On Cape Vogel Pen, conf on Castle Hill Lst; later equiv of and unconf below Ruaba Sst. Dated by foram

	Tmu^4 (contd)	Lavao Formation (Tml) 1 Miocene (Included in Tmm^4)	600; lenses to 200	YULE, NW PORT MORESBY-KALO-AROA: Calcareous tuffaceous sandstone and conglomerate, lenses of biohermal limestone with reef debris*. Lenses of coralgal limestone with calcareous sandstone; breccia, siltstone, and mudstone mapped separately	Shallow-water marine lagoonal envir in which biohermal reefs flanked and intermittently engulfed by reef talus and coarse-grained tuffaceous sed from adjacent delta complex. Conf on Chiria Fm; unconf below Apinaipi Fm; may be unconf below Miaru Mdst in concealed synclinal cores; interf with Talama Volc and Aure Beds. Contains 1 Tf larger benth and plank foram; corals, algae, bry, biv, gast also present
Late Miocene		Tms 1 Miocene (Included in Tmm^4)	0-800	S-CENTRAL WAU: Biohermal limestone and marl grading laterally into marl, limestone, with some sandstone and conglomerate	Unconf on Omaura Gwke and Owen Stanley Metam; abd foram (e Tf) in calc beds
	Units not differentiated from Tmu^4 on 1:1 000 000 map: In Yule: Plio Apinaipi Fm and 1 Mio-e Plio Miaru Mdst (see $Tmm\text{-}p^4$)				
Middle Miocene	Tmm^4	Chiria Formation (Tmc) m Miocene	1700+ (base not exposed in Yule); 1200 in Port Moresby-Kalo-Aroa	PORT MORESBY-KALO-AROA, SE YULE: Greywacke sandstone, siltstone, mudstone; minor pebble and cobble conglomerate; calcareous sandstone, mudstone, siltstone, and minor limestone increase towards top; mudstone increases near base	Rapidly dep in open marine, but nearshore envir on E margin of Aure Trough; immature sed derived from emerging metam and volc terrain to N and E. To W probably grades into trough facies Aure Beds; to E probably grades later to Tmt; grades conf up into Lavao Fm; probably overlies shallow-water marine Te stage (Tmx) sed. Dated as e Tf by larger benth and plank foram. Contains Eo and Te-stage derived lst clasts. Frag microfoss occur throughout
		Gidobada Limestone (Tmg) m Miocene (Partly at least included in Tou^4)	to 100	PORT MORESBY-KALO-AROA: Reefal limestone, calcarenite, calcirudite	Reef complex. Unconf on Port Moresby Beds; non-conf on Sadowa Gb; conf on Kore Volc; unconf below Kwikila Aglm. Dated by larger benth foram; tabulate and rugose corals, frag biv and gast also present. Potential raw material for cement manufacture

Tmm^4 (contd)	Iauga Formation (Tmi) m Miocene	c.1500	S-CENTRAL SALAMAUA: Basalt tuff, mostly shallow-marine, some subaerial	Unconf on Eia Beds. Dated by larger foram (e Tf)
	Langimar Beds (Tmg) m Miocene	to 3000, thins to S	S-CENTRAL MARKHAM: Volcanolithic pebble and cobble conglomerate in tuffaceous matrix; lenses of silty sandstone, basaltic and andesitic agglomerate near base; large detritus limestone lenses; finer-grained and thinner towards S	Shelf facies of late-stage sed in Aure Trough. Unconf on Omaura Gwke and Owen Stanley Metam; unconf below Babwaf Cgl; equiv of Yaveufa Fm to NW. Abd foram in lst lenses
		500-3600	N-CENTRAL WAU: Conglomerate and sandstone, interbedded marl, mudstone and calcarenite to N, with basaltic and andesitic lava and pyroclastics in bottom half; silty mudstone and siltstone with sandstone, grit, and conglomerate to S; biohermal limestone	Unconf on Omaura Gwke and Owen Stanley Metam. Abd e Tf foram in calc beds
Middle Miocene	Castle Hill Limestone (Tmh) m Miocene	120	E TUFI-CAPE NELSON: Reef limestone and calcarenite, moderately to thickly bedded; basal conglomerate	Basal cgl laps on to Dabi Volc; unconf on Woruka Sltst; conf below Tapio Marl. Dated as e Tf by foram. Possible source of lime
	Kido Limestone (Tmki) e-m Miocene (At least in part included in Qa^4)	200+	PORT MORESBY-KALO-AROA: Fossiliferous limestone; fine-grained, well bedded, locally contains volcanic material, partly recrystallized	Reef complex. Although partly younger, may be corr with l Oligo to e Mio seds and volcs; possibly facies equiv and partly time-equiv of Boera Lst, Bootless Inlet Lst, Dokuna Tuff. Dated by larger benth foram; corals, echino, bry, biv, cirripeds, and Lithothamnium also present
	Adau Limestone (Tma) e-m Miocene	100	SW TUFI-CAPE NELSON: Reef limestone and shelly calcarenite	Unconf on Kutu Volc. Dated by foram (l Te, e Tf). Possible source of lime

Units not differentiated, at least in part, from Tmm^4 on 1:1 000 000 map: In Yule: Quat Qt, Qpc, and Qp (see Qa^4);m-l Mio Aure Beds and e Mio Tmx (see Tml^4); and Eo? Aibala Volc (see Te). In Wau: 1 Mio Tms (see Tmm^4); and Eo Te (see Te^4). In Salamaua: Eo Eia Beds (see Te^4). In Port Moresby-Kalo-Aroa: 1 Mio Lavao Fm (see Tmu^4)

Tmm	Mai'iu Monzonite (Tpx) l Miocene-e Pliocene	S TUFI-CAPE NELSON: Xenolithic granodiorite, biotite monzonite, biotite hornblendite*	Intrudes Goropu Metabs and probably Granular gb and Tectonite ultram. Dated by K-Ar method as 4.37, 6.03, and 6.76 m.y. (hbl)
	Suckling Granite (Tmk) l Miocene	TUFI-CAPE NELSON: Medium and coarse granite	Intrudes Tectonite ultram and Goropu Metabs; may be intruded by Mai'iu Monz. K-Ar ages based on hbl (9.4 and 10.8 m.y.) and biot (3.2 and 3.3 m.y.), and may indicate uplift about 3.3 m.y. ago
	Morobe Granodiorite (Tmm) m Miocene	E WAU, NW SALAMAUA, SE MARKHAM: Granodiorite, adamellite; subordinate monzonite, diorite, and pegmatite	In Wau, intrudes Owen Stanley Metam; relat with Omaura Gwke and Langimar Beds not known; possibly contemp with basal volc of Langimar Beds in E Wau. In Salamaua, probably postdates some movements on Owen Stanley Fault system. In Markham, contemp with Bismarck Intr Comp; dated by K-Ar and Rb-Sr methods as 12 m.y. and 14.5 m.y. Source of some Au in Wau and SE Markham
Middle Miocene	Magavara Syenite (Tmm) l Oligocene?-m Miocene (At least in part included in Tp^4)	ABAU, SAMARAI: Syenite, monzonite, minor gabbro; trachybasalt, latite, sanidine melanite porphyry dykes	Dissem py, minor alluv Au S of Dogura Bay
	Imudat Monzonite (Tmi) l Oligocene?-m Miocene	ABAU: Monzonite, minor trachyandesite	Intrudes Kutu Volc. Dissem py and minor alluv Au
	Gabahusuhusu Syenite (Tmg, Tmg^1) l Oligocene?-m Miocene	SAMARAI: Syenite, monzonite, diorite, minor gabbro; dunite mapped separately (Tmg^1)	Intrudes Kutu Volc. Minor Au and Pt mineraliz
	Ulo Ulo, Watuti, and Sige Lele Gabbros (Tmo, Tmw, Tmw^1, Tmb) l Oligocene?-m Miocene	SAMARAI: Gabbro; in places monzonite, pyroxenite; dunite mapped separately (Tmw^1)	Intrude Kutu Volc. Ulo Ulo Gb has Cu and Au mineraliz, dissem py, and possibly Pt. Watuti Gb overlain by Mt Suau Mem of Fife Bay Volc; has dissem py; may be source of alluv Pt. Sige Lele Gb contains dissem py and ch

Tml	Tmi Miocene-Pliocene (Partly at least included in JK^4)		NE YULE: Hornblende diorite, augite microdiorite, intrusive augite and hornblende andesite, augite, hornblende, and minor biotite monzonite, pyroxene gabbro/diorite, feldspar-hornblende-biotite granodiorite; leucocratic, fine to medium, weakly pyritic, and partly silicified*	Part of Mio-Plio volc complex. Intrudes Kagi Metam, Auga Beds, Aibala Volc, Talama Volc, Yaifa Fm, Mt Davidson Volc. Age based on probable relat with Talama Volc and Mt Davidson Volc; intr postdate deformation of Kagi Metam, Auga Beds, Aibala Volc

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Early Miocene

Tml^4	Woruka Siltstone (Tmz) e Miocene	45	SE TUFI-CAPE NELSON: Laminated siliceous siltstone and claystone; minor thin beds of glauconitic silty sandstone	Laps on to Dabi Volc; unconf overlain by Castle Hill Lst. Dated by foram
	Aure Beds (Tm) m Oligocene-l Miocene (m-l Miocene in Yule) (At least in part included in Tmm^4, Tou^4)	2500-2900, thins to W in Wau and Markham; 1000-5700, thickens to E in Karimui; 2000 in Yule	W WAU: Greywacke and siltstone with minor interbedded marl, calcareous siltstone, argillaceous limestone, tuffaceous greywacke, lenses of pebble conglomerate; towards top commonly pebble and boulder conglomerate with abundant volcanic clasts	Base not seen, but cgl contains pebbles of metam rocks; therefore unit probably unconf on Owen Stanley Metam. Abd foram (e Te-l Tf: l Oligo-l Mio)
			SW MARKHAM: Mainly well bedded turbidites; folded massive greywacke with subordinate siltstone, pebbly sandstone, shale; also pelagic limestone lenses	Turbidites dep in Aure Trough. Sequence repeated by much folding and faulting. Possibly unconf on Te; later equiv of Omaura Gwke and Movi Beds; unconf below Yaveufa Fm. Abd plank foram (Td-e Tf: m Oligo-m Mio)
			SE KARIMUI: Mainly massive siltstone; minor hard shale, marl, thin pelagic limestone beds; conglomerate, pebble greywacke, detrital and conglomeratic limestone, mudstone, greywacke siltstone	Apart from trans basin facies, formation consists largely of turbidites; rapid later and vertical variations; well bedded; contains facies trans to Darai Lst. Abd benth and plank foram (Te-Tf: l Oligo-m Mio); frag macrofoss
			NW YULE: Massive resistant medium to coarse poorly sorted greywacke, siltstone, and mudstone give way upsequence to thinly bedded fine greywacke inter-	Deep-water sed derived from emerging metam and volc terrain to N and E, and rapidly dep in Aure Trough. Locally grade upward through trans mdst into Miaru Mdst; base of unit not

	Tml[4] (contd)		bedded with increasing proportion of less resistant soft, finely laminated siltstone and marly mudstone; minor calcareous interbeds; rare lignitic bands and carbonaceous lenses of massive conglomerate	seen; in places overlain by Miaru Mdst; offshore interf with Chiria Fm, Lavao Fm, Tmx?; offshore overlain by thick Pleist-Holo sed. Rare frag corals and molluscs; foram poor, but beds can be corr with Aure Beds in Wau area
Early Miocene	Tmx l Oligocene-e Miocene (At least partly included in Tmm[4], JK[4])	100	E YULE: Calcareous sandstone, limestone, pebble conglomerate*	Shallow-water marine envir. Unconf on Kagi Metam, Auga Beds, and Aibala Volc; to E, probably disconf below Talama Volc; to W, probably conf below Talama Volc, Chiria Fm; probably interf with Aure Beds. Contains coralgal reef faunas with larger benth foram assem (l? Te); many clasts contain derived Eo faunas
	Modewa River, Padowa, and Debolina Beds (Tme, Tme[1], Tmp, Tmd) l Oligocene-Miocene	200-1000	SAMARAI: Tuffaceous sandstone. Modewa River Beds also contain limestone, tuffaceous siltstone, and graded-bedded sandstone and siltstone	All unconf on Kutu Volc, and dated by foram; Modewa R Beds also unconf on Badila Beds and overlain by Fife Bay Volc and its Mt Suau Mem
	Unit not differentiated from Tml[4] on 1:1 000 000 map: In Wau: Eo Te (see Te[4])			
Late Oligocene - Middle Miocene	Tou[4]	Kore Volcanics (Tmk) m Miocene	to 250	PORT MORESBY-KALO-AROA: Basaltic and andesitic pyroclastics, lava, volcanic sandstone; to E, includes fine-grained marine tuff with volcanic conglomerate near base	Subaerial and shallow marine volc; broken up, altered, and weathered intermediate to basic pyroclastics. Unconf on Port Moresby Beds; non-conf on Sadowa Gb; conf below Gidobada Lst
		Boera Limestone (Tmbo) l Oligocene-e Miocene	c.300	W PORT MORESBY-KALO-AROA: Reefal limestone, tuff, lapilli tuff, tuffaceous sandstone, limestone breccia*	Reef complex, contemp volc, and erosion of Port Moresby Beds and older landmass. In fault contact with Port Moresby Beds; possibly facies and time equiv of Bootless Inlet Lst and Dokuna Tuff, and partly time equiv of Kido Lst. Dated by larger benth foram; corals and indet plant remains also present; some foss reworked from older units

Late Oligocene - Middle Miocene	Tou^4 (contd)	Bootless Inlet Limestone (Tmb) 1 Oligocene-e Miocene (Partly at least included in Te^4)	to 50	W PORT MORESBY-KALO-AROA: Calcarenite with volcanic detritus; minor calcareous tuff	Patchy reef complex in shallow-marine envir with nearby explosive volc; adjacent landmass probably to N. Deformed after dep. May be corr of Boera Lst. Dated by larger benth foram; sponge spicules, echino, and bry also present
		Dabi Volcanics (Tod) 1 Oligocene	50	E TUFI-CAPE NELSON: Basaltic lava, pillow lava; minor tuff, limestone	Probably represent basement of Cape Vogel Basin. Unconf overlain by Woruka Sltst, etc. Dated by K-Ar whole-rock method as 28 ± 1 m.y. and by assoc Te foram; some conflicting evidence of Paleocene or older age
		Omaura Greywacke (Tou) m-l Oligocene	3000+ in Markham	MARKHAM, WAU: Tuffaceous shale and sandstone interbedded with massive greywacke, pebble conglomerate, and lithic sandstone; extensive calcareous breccia near base; reef limestone lenses common; minor lava and pyroclastics; thick massive foraminiferal limestone locally near top	Turbidite sed in Aure Trough. Contains abd derived Eo foram in calc lenses, and hence considered unconf on Chimbu Lst; conf on Nasananka Cgl; unconf on Bena Bena Fm; unconf below Yaveufa Fm, Babwaf Cgl, lava and pyroclastics of Marawaka area, and Pleist lake beds; later equiv of part of Aure Beds; grades W into sed of trough facies; intruded by Elandora Po and Akuna Intr Comp. M-l Oligo in Markham on abd foram
				KARIMUI: See Tou^3 (under Region 3)	

Units not differentiated from Tou^4 on 1:1 000 000 map: In Markham: Pleist Qpa (see Qv^4). In Port Moresby-Kalo-Aroa: m Mio Gidobada Lst (see Tmm^4); and m Oligo-l Mio Aure Beds (see Tml^4). In Wau: Eo Te (see Te^4)

Oligocene - early Miocene	To	Dokuna Tuff (Tmd) 1 Oligocene-e Miocene (Included in Te^4)	80-500	W PORT MORESBY-KALO-AROA: Andesitic and basaltic vitric, crystal, and lithic tuff; minor agglomerate; partly calcareous with volcanic fragments in brecciated limestone matrix	Submarine explosive volc with nearby reef growth. Interf with Bootless Inlet Lst; unconf on Port Moresby Beds; non-conf on Sadowa Gb; may be corr of Boera Lst and Kido Lst. Dated by larger benth foram in calc matrix; some Eo derived foram. Pavement agg for unsealed roads

Oligocene - early Miocene	To (contd)	Sadowa Gabbro (Tos) 1 Eocene-m Oligocene	700+	PORT MORESBY-KALO-AROA: To W, gabbro with medium to coarse granular allotriomorphic/hypidiomorphic, minor ophitic, and glomeroporphyritic textures; diorite and other acid differentiates (granophyre); to E, fine-grained gabbro, dolerite, basalt; generally gabbro chilled against host rock; low-K tholeiite composition*	Elongate intr (possibly partly extr) body of batholith size. Intrudes Kemp Welch Beds, Port Moresby Beds, and Kutu Volc; unconf below Bootless Inlet Lst, Dokuna Tuff, Kore Volc, Gidobada Lst, Siro Cgl, Astrolabe Aglm, Kwikila Aglm, and Tpy; intruded by shallow intr bodies related to Mt Cameron volc comp. Age from struc and strat contact relat with Port Moresby Beds, Dokuna Tuff, and Bootless Inlet Lst. Selected Cu mineraliz of dissem ch; secondary minerals cc, ml, az. Weathered gb used for surfacing roads

Units not differentiated from To on 1:1 000 000 map: In Port Moresby-Kalo-Aroa: Pleist Ararabu Cgl (see Qs^4); l Mio-e Plio Siro Cgl (see $Tmm\text{-}p^4$); and e-m Eo Port Moresby Beds (see Te^4)

Middle Eocene	Te	Imo Tonalite (Tei) Eocene	E PORT MORESBY-KALO-AROA, W TUFI-CAPE NELSON: Tonalite, some granophyric diorite	In Port Moresby-Kalo-Aroa, intrudes Cumulate gb, High-level gb, Lokanu Volc; age 50-55 m.y. from tentative corr with Eo tonalites in N part of Papuan Ultram Belt; potential for Au and Cu mineraliz. In Tufi-Cape Nelson intrudes only Lokanu Volc
		Kui Tonalite (Tek) Eocene	SALAMAUA: Hornblende tonalite (quartz diorite), augite tonalite, and some diorite	Intrudes Tectonite ultram, Granular gb, High-level gb, and Lokanu Volc; genetically related? to volc component of Eia Beds. Source? of Au and Cu mineraliz; some late-stage alteration to qtz, ep, py, and ch
		East Cape Gabbro (Tee) m Eocene?	SAMARAI: Gabbro	Mineralogically similar to Kutu Volc; dissem py
		Aibala Volcanics (Tea) Eocene? 3000	E YULE: Spilitized submarine basalt intruded by dolerite dykes; minor lenses of chert, limestone, siltstone,	Submarine envir in which autobrec spilitized lavas intcal with deep-water siliceous mdst and chert. May interf with and possibly partly

Middle Eocene	Te (contd) (At least in part included in Tmm^4)		shale*	overlie Auga Beds; unconf below Tmx and Talama Volc; Eo? age based on occurrence of Aibala Volc-type basalt within foss Eocene 1st of Auga Beds, on occurrence of chert horizons in both Aibala Volc and Auga Beds, and on intcal of Aibala Volc and Auga Beds locally
	Te^4 Bomuguina Beds (Teb) Eocene (At least in part included in Qs^4, Tp^4)	500+	SE PORT MORESBY-KALO-AROA: Calcilutite, siltstone, sandstone; minor chert; well bedded	Dep in shelf and deep-sea envir. Possibly corr with Port Moresby Beds; unconf below Cloudy Bay Volc, Kupiano Beds, Ararabu Cgl. Dated by plank foram
	Godaguina Beds (Teg) Eocene	c.100	SW TUFI-CAPE NELSON: Marl and calcilutite	Probably lenticular body within Kutu Volc. Dated by foram
	Juliade Limestone (Tej) m Eocene	500-1000	ABAU: Limestone with flint nodules; finely interbedded limestone and chert	May conf overlie or interf with Kutu Volc. Dated by plank foram
Eocene	Te Eocene (Included in Tou^4, Tml^4)		WAU: In S, siliceous marl and chert; in N, lenses of coral limestone with some conglomerate	Siliceous sed corr of Eo chert of Port Moresby Beds; lst contains possibly derived Eo foram
	Eia Beds (Tee) (At least in part included in Tmm^4)		COASTAL SALAMAUA: Marine dacitic/andesitic tuff, breccia, lava, volcanic necks	Unconf? on Lokanu Volc; unconf? below Iauga Fm. Volc component probably genetically related to Eo tonalites. Age based on plank foram
	Kutu Volcanics (KTk, KTk_1, KTk_2) L Cretaceous-m Eocene (Partly at least included in Ku^4, Te^5)	3000-4000 in Tufi-Cape Nelson;	TUFI-CAPE NELSON: Basaltic lava, pillow lava, dykes; minor calcilutite	Eo in W(KTk_2), Cret in E (KTk_1), based on foram in intcal lst lenses (also in Samarai and Abau). Some ch and py in qtz veins; rare native Cu in lavas

Te^4 (contd)	Kutu Volcanics and Touiawaira Limestone Member (KTk, KTk_1, KTk_2, Tet) m Eocene (Partly included at least in Ku^4)	3000+ 3-7 (member)	SAMARAI, ABAU: Also minor gabbro, microgabbro, rare ultramafics; some tuffaceous arenite, argillite; foraminiferal limestone lens (Tet in Samarai only)	Minor sulphide mineraliz near Mio intrusives. In Abau scattered evidence from foram suggests L Cret age in N (KTk_1), m Eo remainder (KTk_2), possible Paleo hiatus
	Kutu Volcanics (KTk) Eocene	2000	PORT MORESBY-KALO-AROA: As above but also some dolerite intrusions and dykes	Probably oceanic crust formed during rifting open of Coral Sea in L Cret and Eo. Overlies and interf with Kemp Welch Beds; unconf below Domara R Cgl, Musa Volc Mem, Tpy, Cloudy Bay Volc; relat with Papaun Ultram Belt not clear - probably imbricate thrust-fault contact; intruded by Sadowa Gb. Dated by plank foram. Minor sulphide mineraliz near Mio intr
Eocene	Foasi River Limestone Member (of Kutu Volcanics) (Tef) Eocene	to 50	SE PORT MORESBY-KALO-AROA: Recrystallized laminated limestone; numerous calcite veinlets	Dep in deep-sea envir. Lenses in Kutu Volc. Dated by poor plank foram
	Amora Conglomerate (Tea) Eocene	c.300	E PORT MORESBY-KALO-AROA: Conglomerate with schist, quartz, metadolerite, and basalt clasts; minor agglomerate	Probably littoral to sublittoral envir. Overlies? Lokanu Volc; presence of clasts of Kagi Metam, Emo Metam rock types, and basic volc material suggests dep during or after emplacement of Papuan Ultram Belt; degree of lithification and jointing suggests Palaeogene rather than Neogene
	Port Moresby Beds (Tem) e-m Eocene (Partly at least included in To)	c.2000	COASTAL PORT MORESBY-KALO-AROA: Argillite, siliceous argillite, shale, calcilutite; minor chert and calcarenite; generally well bedded but other sedimentary structures rare	Dep in deep-sea envir mostly on continental slope or rise; occurrence of calcaren suggests local shelf envir. Unconf on Bogoro Lst; contact with Kemp Welch Beds obscured by intr of Sadowa Gb, but probably partly overlie and partly grade later into Kemp Welch Beds; unconf

Eocene	Te^4 (contd)				below Bootless Inlet Lst, Dokuna Tuff, Kore Volc, Gidobada Lst, Siro Cgl, Astrolabe Aglm, Kwikila Aglm, Tpy; corr with Bomuguina Beds, up part of Auga Beds in Yule, and Juliade Beds in Abau; includes Varirata arg, Paga chert, Nebire lst, and Tatana calcaren, only diff in areas of detailed mapping. Dated by plank and larger benth foram; radiolarians, sponge spicules, bry, echino, molluscs, plates and columnal joints of crinoids, corals?, fish teeth? also present
		Baruni Calcarenite (Tlb) Paleocene	c. 70	W PORT MORESBY-KALO-AROA: Bedded biocalcarenite, biocalcrudite; minor interbedded recrystallized argillaceous limestone	Sublittoral envir. Strat relat not clear, but assumed to underlie Port Moresby Beds. Dated by larger benth forams and algae; some derived L Cret forams. Potential raw material for cement.
	Units not differentiated, at least in part, from Te^4 on 1:1 000 000 map: In Port Moresby-Kalo-Aroa: 1 Oligo-e Mio Bootless Inlet Lst (see Tou^4); 1 Oligo-e Mio Dokuna Tuff (see To); and L Cret Bogora Lst (see Ku^4)				
Early Paleocene	K	Unit mapped as K on 1:1 000 000 map: In Tufi-Cape Nelson: L Cret Yau Gb (see Ku^4)			
Late Cretaceous	Ku^4	Badila Beds (Ktb) L Cretaceous-m Eocene	1000 in Abau	E ABAU, W SAMARAI: Limestone, calcilutite, shale, argillite, calcareous tuff; minor basalt	May interf with Kutu Volc. Some interbeds in Samarai contain uneconomic grades of ph. Dated by plank foram
		Goropu Metabasalt and Bonenau Schist Member (Kw, Kw_1; Kb, Kb_1, Kb_2) L Cretaceous	3000-4000; Member 1000	TUFI-CAPE NELSON: Metamorphosed basalt, dolerite, ophitic gabbro; some hyaloclastite, some impure limestone interbeds; metamorphosed to prehnite-	Originally pile of deep ocean bs (oceanic up crust) metam by underthrusting? Metam grade decreases systematically to SE; metam equiv of Cret part of Kutu Volc; later equiv of Lokanu

Ku4 (contd)			pumpellyite and pumpellyite-bearing greenschist, and greenschist facies*. Member consists of calcareous schist and variably schistose limestone; some hornfels*	Volc. Rare dissem ch. Includes calc beds mapped separately as mem; originally lst lens or lenses within pile of oceanic bs; dated by plank foram
	Yau Gabbro (Ky) L Cretaceous (Included in K)		S TUFI-CAPE NELSON: Gabbro, diorite, granophyric tonalite*	Probably subvolc pluton related to Goropu Metabs and Kutu Volc. Intrudes and has hornfelsed Bonenau Schist Mem before area regionally metam; age deduced from these relat
	Bogoro Limestone (Kub) L Cretaceous (Partly at least included in Te^4)	to 30	COASTAL E PORT MORESBY-KALO-AROA: Argillaceous biomicrite; minor calcareous shale generally sheared or contorted	Bathyal envir. In fault contact with or unconf below Port Moresby Beds. Dated by plank foram. Potential raw material for cement manufacture
Late Cretaceous	Nipanata Beds (Kn) Jurassic?-Cretaceous	c.500	W SALAMAUA: Marl, impure limestone; fine-grained arenitic and pelitic sediments, mostly calcareous; some low greenschist facies metamorphism	Probably interf with Lokanu Volc. Dated in part by poor forams in Salamaua
	Lokanu Volcanics (Ka) Jurassic?-Cretaceous	1000+ in Port Moresby-Kalo-Aroa; c.1000 in Tufi-Cape Nelson	E PORT MORESBY-KALO-AROA, TUFI-CAPE NELSON: Massive basalt, basaltic and spilitic lava, and pillow lava; uralite, epidote, chlorite, and silica alteration; locally metamorphosed to prehnite-pumpellyite, greenschist, and amphibolite facies near major faults; include some fine-grained and calcareous sediments in Tufi-Cape Nelson	In Port Moresby-Kalo-Aroa, probably overlie Granular gb and High-level gb with trans contact; unconf below Sesara Volc, Domara R Cgl, Musa Volc Mem, Amora Cgl, Manna Volc; intruded by Imo Tonalite; probably unmetam equiv of Emo Metam; dating by K-Ar method of 116 m.y. based on assoc with gb and ultram of Papuan Ultram Belt; host for minor ch-py (py-ep-qtz) mineraliz. In Tufi-Cape Nelson, probable later equiv of Cret part of Kutu Volc and Goropu Metabs; some ch in amygdules

Units not differentiated, at least in part, from Ku^4 on 1:1 000 000 map: In Abau and Tufi-Cape Nelson: L Cret-Eo Kutu Volc (see Te^4); and Jur?-Cret Owen Stanley Metam (see JK^4)

JK^4	Auga Beds (KTa) L Cretaceous-Eocene (part Senonian, part m Eocene) (At least in part included in Tmm-p^4)	500	NE YULE: Massive siltstone, indurated shale, calcareous subgreywacke, feldspathic sandstone, pebble conglomerate; massive, algal foraminiferal biosparite, detrital limestone, calcareous sandstone, siliceous limestone, chert*	Fore-reef envir. In places difficult to distinguish from Kagi Metam into which may grade with increase of metam; may interf with and possibly partly underlie Aibala Volc; intruded by Tmi. Sen foram at one locality; Eo and m Eo plank and benth foram; algae and bry in some other lenses
	Kemp Welch Beds (KTw) L Cretaceous-e Eocene	c.3000	PORT MORESBY-KALO-AROA: Argillite, shale, slate, siltstone; minor lithic and feldspathic sandstone and greywacke; rare argillaceous biomicrite, polymictic orthoconglomerate, and interbedded spilitic volcanics; slate at base of section and calcareous sediments most common in upper part of sequence*	Turbidites dep on continental slope and deep ocean floor. Partly overlie and partly grade later into Kagi Metam - arbitrary contact along chl isograd; underlie and partly grade later into Port Moresby Beds; probably interf with Kutu Volc; intruded by Sadowa Gb; unconf below Mt Davidson Volc, Astrolabe Aglm, and Tpy, and intruded by shallow porphyritic intr related to these volc; corr with Auga Beds in Yule. Dated by plank foram. Py along joint linings and in fracture zones where intr by small bodies of po; ch and pyrrh
Jurassic? - Eocene? Owen Stanley Complex	(Emo Metamorphics ((Ke) (Jurassic?-Cretaceous	800-1200	NE PORT MORESBY-KALO-AROA: Massive basic schist derived from basalt, dolerite, gabbro, volcanic sediment; minor calcareous and sialic phyllite and schist; metamorphism intermediate between greenschist facies and lawsonite-glaucophane schist facies; chemical analysis suggests low-K oceanic tholeiitic composition of basic schist*	Oceanic crust. Discordant contact with Kagi Metam possibly due to thrusting rather than strat unconf; probably metam equiv of Lokanu Volc; equiv of Goropu Metabs and Bonenau Schist Mem in Tufi. Age based on corr with these units
	(Kagi Metamorphics ((Kk, Ko) (Jurassic?-Cretaceous ((At least in part in- (cluded in Tmm-p^4)	10 000	NE YULE, PORT MORESBY-KALO-AROA: Slate, phyllite, schist, minor gneiss; predominantly pelitic metasediments: pyritic slate, and sericite, chlorite, quartz-graphite, and quartz-albite-	In Yule, thick marine sed possibly dep in deep geosynclinal basin peripheral to N margin of Australian cratonic landmass; base of fm not exposed; unconf below Tmx, Talama Volc; appears to grade with decreasing metam into, and be

JK^4 (contd)			mica-chlorite schists; rarer low-grade psammites identifiable as metamorphic subgreywacke, quartzite, siltstone, pebble conglomerate, interbeds of meta-volcanics. In Port Moresby-Kalo-Aroa, Barrovian-type greenschist facies with progressive metamorphism from chlorite zone, through biotite zone, to garnet zone. Ko in Yule: medium to coarse schist with typical minerals quartz, muscovite, epidote, garnet, amphibole; higher-grade greenschist facies	conf under, Auga Beds; up part may grade inco Auga Beds with Sen and mid-Eo foss; intruded by Tmi; Cret macrofoss in related metam near Wau; strat relat with Auga Beds suggest age older than L Cret; age of metam not certain, but isotopic dating of Kaindi Metam and Goroka Fm suggest Oligo-e Mio age; if metam coeval with emplacement of Papuan Ultram Belt, age would be Eo or Oligo. In Port Moresby-Kalo-Aroa, generally similar;underlies and grades later into Kemp Welch Beds; arbitrary contact with Kemp Welch Beds established along chl isograd; unconf below Mt Davidson Volc, Astrolabe Aglm, Sesara Volc, Efogi Volc; intruded by shallow intr (Tpy) and Oveia Dr; Au assoc with py in qtz veins, in gossan, and in alluv; py very common; ch and pyrrh rare; gt common accessory in pelitic metam
Jurassic? - Eocene?	Owen Stanley Metamorphics (Name now obsolete) (Ko) Jurassic?-Cretaceous (Partly at least included in Ku^4)	c.10 000	E WAU, W SALAMAUA, SE MARKHAM: Predominantly low-grade metamorphics; quartz-sericite, andalusite, and quartz-chlorite schists; slate, phyllite; in places, metagreywacke, metaconglomerate, recrystallized limestone; in other places, higher-grade rocks such as quartz-albite-sericite, quartz-albite-muscovite, and epidote-chlorite-actinolite schists with occasional almandine and amphibole	Main metam probably in Eo or Oligo; again possibly in Mio (Te-e Tf). Base of metam not exposed. Cret macrofoss in Wau, but age probably Jur-Cret. In Wau and Markham, intruded by Edie Po, Morobe Gd; unconf below Babwaf Cgl and Langimar Beds. In Salamaua, intruded by Tmm; metam source of alluv Au
			SW TUFI-CAPE NELSON: Fine-grained basic and quartz-calcite-sericite schist of greenschist facies; typical assemblage quartz-chlorite-albite-actinolite	Possibly mark trace of thrust fault; later equiv of Bonenau Schist Mem and Goropu Metabs. Age based on struc interpretation

Units not differentiated, at least in part, from JK^4 on 1:1 000 000 map: In Yule: m-l Mio Talama Volc (see $Tmm\text{-}p^4$); e Mio Tmx (see Tml^4); and Mio-Plio Tmi (see Tml). In Port Moresby-Kalo-Aroa: Pleist Efogi Volc (see Qv^4); and l Mio? Oveia Dr (see Tmu^4). In Markham: Mio-Plio Edie Po (see TpQp)

Jurassic - Cretaceous	JK	High-level gabbro (Kh) Jurassic?-Cretaceous	1000	NE PORT MORESBY-KALO-AROA, SE TUFI-CAPE NELSON, W SALAMAUA: Gabbro with zoned plagioclase and/or ophitic texture	Occurs at top of gb zone and probably trans to bs zone. Age from assoc with other units of Papuan Ultram Belt
		Granular gabbro (Kg) Jurassic?-Cretaceous (Partly at least included in TT)	3000-4000	NE PORT MORESBY-KALO-AROA, SE TUFI-CAPE NELSON, W SALAMAUA: Granular gabbro; includes streaky gabbro, gabbro pegmatite, and undifferentiated High-level gabbro and Cumulate gabbro fragments; texture allotriomorphic or hypidiomorphic*	Intrudes Tectonite ultram, Cumulate ultram, Cumulate gb; probably cogenetic with Cumulate ultram, Cumulate gb, High-level gb, Lokanu Volc. Jur age (147-150 m.y.) suggested by K-Ar dates in Buna; Cret age suggested by assoc with Lokanu Volc and Kutu Volc. Potential for Cu and Ni sulphide mineraliz
		Cumulate gabbro (Kc) Jurassic?-Cretaceous (Partly at least included in TT)	c.1000	NE PORT MORESBY-KALO-AROA, SE TUFI-CAPE NELSON, W SALAMAUA: Cumulate gabbro, some with compositional layering, mineral-graded bedding, and scour-and-fill structures*	Low oceanic crust, probably subvolc plutons related to Lokanu Volc. Intruded by Granular gb; may be trans to Cumulate ultram. Potential for Cu and Ni sulphide mineraliz
		Cumulate ultramafics (Ku) Jurassic?-Cretaceous (Partly at least included in TT)	to 500	NE PORT MORESBY-KALO-AROA, TUFI-CAPE NELSON, W SALAMAUA: Ultramafic rock with cumulus texture*	Probably trans upwards into Cumulate gb
Triassic? - Cretaceous	TT	Tectonite ultramafics (U) Mesozoic or older	4000-8000	NE PORT MORESBY-KALO-AROA, TUFI-CAPE NELSON, SALAMAUA, E WAU: Ultramafic rock with tectonite texture, indicating recrystallization in solid state; typical rocks: hartzburgite and dunite with enstatite pyroxenite*	Includes some Cumulate ultram in areas mapped in lesser detail; underlies Cumulate ultram with presumed non-conf, and probably with them represent up mantle; may be refractory residue formed by partial melting of pyrolite mantle to produce bs magma. No age evidence

Units not differentiated, at least in part, from TT on 1:1 000 000 map: In Port Moresby-Kalo-Aroa: Pleist Qpg (see Qv^4). In Tufi-Cape Nelson: Pleist Sivai Brec Mem (see Qv^4); Pleist Ibau Brec (see Qs^4); and Jur?-Cret Cumulate gabbro (see JK). In Salamaua: Jur?-Cret Granular gb and Cumulate ultram (see JK)

PAPUAN ISLANDS (5)

Age	1M map unit	Constituent unit(s) in 1:250 000 Sheet areas	Thickness (m)	Lithology	Additional pertinent data
Quaternary	Qa^5	Qa, Qs Quaternary	to 500	SAMARAI, FERGUSSON I: Alluvium: gravel, sand, silt, clay; beach deposits. Colluvium: talus, landslide debris; angular boulders of various sizes commonly in clay matrix	On N coast of Basilaki, Sideia, and Sariba Is; N, SW, and SE coast of Goodenough I. On central Fergusson I, SW and NE Goodenough I, and large parts of Normanby I alluv Au; large groundwater reservoir; heavy-mineral (rut) potential, but quantity limited
		Qc Pleistocene-Holocene	to 100	FERGUSSON I, DEBOYNE: Raised coral limestone (bioherm), mostly not recrystallized	On E and S Sanaroa I, and on Deboyne Is (Smith & Pieters, 1969): interf with alluv and volc dep; source of lime and cement
			90+	TROBRIAND IS: Includes also swamp mud, alluvium, marine clay, conglomerate	Kiriarina, Kitava, and Kaileuna Is
	Qv^5	Goodenough Volcanics (Qg) Quaternary	to 500	FERGUSSON I: Basaltic andesite lava, some agglomerate, some rhyolite or dacite; mostly porphyritic	On E Goodenough I, overlie metam ultram, and alluv. Suitable for concrete agg and road gv
		Sebutuia Volcanics (Qe) Pleistocene-Holocene	1000-2000	FERGUSSON I: Rhyolite pumice and obsidian, ashflow tuff; trachyte?, dacite?, minor dolerite	On SE Fergusson I, N Sanaroa, and Dobu I, overlie metam and ultram. Pumice may be suitable for lightweight concrete agg
	Unit also included in Qv^5 on 1:1 000 000 map: In Fergusson I: Plio-Pleist Kukuia Volc (see Tp^5)				

Quaternary	Qs^5	Q, Qa, Ql, Qc Quaternary		DEBOYNE, SAMARAI, WOODLARK I: Raised coral limestone, commonly recrystallized to coarse calcite; in places, soft marine clay and silt with large thick lenses of boulder and pebble conglomerate; in places, clay becomes more calcareous upwards and grades into overlying coral limestone	On Woodlark (Trail, 1967) and Marshall Bennett Is, unconf on volc rocks; raised from 50 to 427 m ; contain abd marine macrofauna - apparently Recent and carb wood and seeds in places; Au has been worked from cgl; around volc outcrops fine and coarse sed contain alluv Au accumulated on top of coral lst. Also present on E islands of Engineer Group, other very small and scattered islets, and Deboyne Group (Smith & Pieters, 1969). On S Misima I (de Keyser, 1961), contains corals, algae, bry

Unit not differentiated from Qs^5 on 1:1 000 000 map: Tert vent brec (see $Tmm\text{-}p^5$)

Pliocene-Quaternary	TpQp	Pana rora Volcanics (Tpu) Pliocene-Pleistocene? (Partly at least included in Tmu^5)	200	CALVADOS: Bedded coarse unsorted volcanic agglomerate, medium massive well sorted conglomerate, minor tuff, and one lava flow; agglomerate contains pyroxene and hornblende andesites	In Calvados Chain: Moterina I and islands W of it (Smith & Pieters, 1969), overlie Calvados Schist and intermediate intr; no evidence for age, apart from fresh appearance
		Luboda, Omara, Observation Island, Gidogidora Granodiorites (Tpg, Tpgl, Tpgo, Tpgb, Tpgg) Pliocene		FERGUSSON I: Granodiorite; minor tonalite, adamellite, granite; xenoliths of altered gabbro, hornfelsed metamorphics, ultramafics	On NW Normanby I, overlain by Normanby Volc. On NW Normanby I and Ubuia I, intrudes metam and ultram. On Fergusson and Normanby Is, 1.8-2.7 m.y. old by K-Ar method on biot separates from seven samples. On Fergusson, Normanby, and Goodenough Is, base metal and Au mineraliz probably related to these intr

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Pliocene	Tp^5	Mwatebu Sandstone (Tpt) Pliocene	100	SAMARAI: Poorly consolidated sandstone, conglomerate, and siltstone with shelly interbeds	On Normanby I, fluvial and shallow marine sed; unconf on Kurada Metavolc and Mb
		Tpv Pliocene (Partly at least included in Te^5)		SAMARAI: Basic volcanics	Islands in Samarai.

Pliocene	Tp^5 (contd)	Kukuia Volcanics (TpQk) Pliocene-Pleistocene (Included in Qv^5)	to 500	FERGUSSON I: Rhyolite, rhyolite obsidian, trachyte, andesite ashflow tuff, some basalt	On SW Fergusson I, overlie metam and alluv
		Normanby and Amphlett Volcanics (Tpn, Tpm) Pliocene (Tpn partly at least included in JK^5)	to 2000	FERGUSSON I, SAMARAI (Normanby Volcanics only): Andesitic lava with some rhyolite, dacite, trachyte, trachyandesite, and olivine basalt; basaltic agglomerate	On Normanby I, Duchess I, and islands NE of Fergusson I, lack of volc landforms suggests Plio. Agg for roads
Pliocene - Middle Miocene	$Tmm-p^5$	Vent breccia Tertiary (Included in Qs^5)		WOODLARK I: Large angular blocks of porphyritic andesite or basalt in matrix of small rock fragments	Manau Hill, Woodlark I (Trail, 1967)
		Granite, porphyry, felsite Tertiary		WOODLARK I: Coarse biotite-hornblende granite with elongated xenoliths of basic volcanic rock in medium groundmass of orthoclase, albite, quartz, and pyrite; porphyries with phenocrysts of feldspar and mafic minerals in fine groundmass; boulders of felsite	On SW Woodlark I (Trail, 1967), Au-bearing
Late Miocene	Tmu^5	Liak Conglomerate (Tml) l Miocene	c.213	DEBOYNE: Conglomerate with mostly well rounded boulders and pebbles composed of amphibolite, greenschist, porphyry, quartz, schists, and dolerite, with rare pebbles of Tertiary limestone; sandy in places; pebbles coated with limonite	On central Misima I (de Keyser, 1961), overlaps and probably interf with Gulewa Fm, possibly with local unconf. Dated by foram

	Tmu^5 (contd)	Gulewa Formation (Tmg) 1 Miocene		DEBOYNE: Conglomerate, sandstone, greywacke, siltstone, pebbly sandstone, intraformational breccia, tuffaceous and calcareous beds, partly corallogene limestone member; conglomerate and breccia, fine to coarse, well to poorly sorted with pebbles and cobbles of variable roundness; sandstone ranges from fine to very coarse, poorly sorted, and rounded; mudstone and siltstone generally massive	On N Misima I (de Keyser, 1961), abd biv, corals, bry, foram
Late Miocene		Kobel Volcanics (Tmk) 1 Miocene	c.305	DEBOYNE: Agglomerate, volcanic conglomerate, tuff, ash beds, and flows generally of trachytic and andesitic lava	On N Misima I (de Keyser, 1961), in places volc interf with and succeeded by sed of Gulewa Fm
	Unit not differentiated, at least in part, from Tmu^5 on 1:1 000 000 map: In Calvados: Plio-Pleist? Pana rora Volc (see TpQp)				
	Tml^5	Nasai Limestone (Tnj) e Miocene	183	WOODLARK I: Fine-grained massive hard limestone, well bedded when weathered	On SW Woodlark I (Trail, 1967), unconf on Loluai Volc and assoc dl sills. Dated by foram; may be younger than Okiduse Volc, but field evidence indicates only that it is younger than intr of Tert dl
Early Miocene		Okiduse Volcanics (Toa, Tov, Toc) e Miocene	610	WOODLARK I: Banded hard tough tuff overlain by thick lava, tuff, volcanic agglomerate, conglomerate; mainly porphyritic and non-porphyritic andesitic basalt*	On SW Woodlark I (Trail, 1967), disconf on Wonai Hill Fm; main source of alluv dep; py common to abd
		Wonai Hill Formation (Twc, Twt, Twm) e Miocene	260	WOODLARK I: Group of tuffaceous rocks at base, fine to medium, massive, well bedded, apparently unmetamorphosed; thin beds of tuffaceous siltstone, shale, and conglomerate interbedded with tuffs; overlying conglomerate has fragments of volcanic rocks in tuffaceous matrix; mudstone massive, uniform, with few silty lenses, some thick*	On SW Woodlark I (Trail, 1967), unconf on Loluai Volc and dl; in places fm and underlying Tabukui Beds separated by disconf; in some places topmost mdst overlain by sltst of Okiduse Volc, but in others by cgl; locally probable source of alluv Au

Early Miocene		Tabukui Beds (Ttc, Ttv) e Miocene	550	WOODLARK I: Fine-grained tuff and subordinate siltstone and thin beds of mudstone with common thin lenses of massive volcanic conglomerate and agglomerate, and occasional large lens of conglomerate near base; beds massive to well laminated, usually cleaved, hard and tough*	On SW Woodlark I (Trail, 1967), basal cgl in places probably unconf on Suloga Lst; in other places tuff overlies lst; at one place tuff grades down into calc sltst at top of Sulogo Lst. Probable source of Au in Suloga area; py abd; layers represented by thin beds of massive lim
		Suloga Limestone (Ts) e Miocene	152	WOODLARK I: Limestone, fine-grained, massive to well bedded, with small pyrite crystals both in matrix and in thin calcite veins	On SW Woodlark I (Trail, 1967), dated by foram
		Panasia Limestone (Tme) e Miocene		CALVADOS: Medium to fine limestone composed of calcareous microfaunal remains in matrix of fine-grained calcite	In W Calvados Chain, Panasia, Panavara vara, and Nasakoli Is (Smith & Pieters, 1969; Smith 1973), old reef dated by Te foram
		Sewa Beds (Tms) e Miocene	1000-2000?	FERGUSSON I, SAMARAI: Andesitic lava, agglomerate; volcanolithic conglomerate and arenite; dense limestone	On central Normanby I, unconf overlain by Normanby Volc; dated by foram (1 Te) S of Fergusson I map area
Olig-ocene	Tl^5	Units included in Tl^5: In Woodlark I: Tert dolerite and Tert? Loluai Volc (see Tl)			
Eocene - Oligocene	Tl	Dolerite Tertiary (Included in Tl^5)	610+	WOODLARK I: Medium-grained massive dolerite with many xenoliths of basic volcanic rock*	On SW Woodlark I (Trail, 1967), separate Loluai Volc, or overlie pillow lava of Loluai Volc, or invade cgl member of Tabukui Beds; skarn rock developed on margin of dl sill complex contains in places 0.2 to 6% Cu; some Cu-Fe mineraliz also present; mt bodies in skarn outcrops; mt and ch mineraliz in dl
		Loluai Volcanics (Tls, Tlv) Tertiary? (Included in Tl^5)	460+	WOODLARK I: Massive tuff, lava, pillow lava, and thin agglomerate; thermally metamorphosed, sheared and intruded, and cut by irregular veins of epidote	On SW Woodlark I (Trail, 1967), overlain unconf by e Mio Wonai Hill Fm and probably unconf by e Mio Suloga Lst; very similar to Tert volc higher up in succession; base not visible; pro-

Eocene - Oligocene		Tl (contd)		and quartz; partly recrystallized; mainly pyroxene andesite or andesitic basalt; interbedded indurated siltstone and mudstone with shale and thin beds of quartzite; local dolerite with large inclusions of indurated basalt	bable source of Au in Suloga area; contain small lode of mn oxides at Wasilas Point; mt, hem, and ml mineraliz also occurs in these beds; both Fe and Cu mineraliz confined to skarn
		Acid intrusives Tertiary		ROSSEL: Granite	On W Sudest I (Smith & Pieters, 1969), possible source of Au-bearing qtz veins intruding schists
		Basic and intermediate intrusives (not differentiated) (Ti) Tertiary		DEBOYNE, ROSSEL: Basic intrusives, medium to coarse; intermediate intrusives are diorite, microdiorite, porphyritic microdiorite; andesite markedly porphyritic*	On S Rossel, Sudest, Panapompom, and Nivani Is of Deboyne Gp (Smith & Pieters, 1969), intrude Calvados Schist
Eocene	Te^5	Units not differentiated, at least in part, from Te^5: In Samarai: Plio Tpv (see Tp^5); and L Cret-m Eo Kutu Volc (see Te^4 under Region 4)			
Jurassic - Early Cretaceous	JK^5	D'Entrecasteaux Complex	Md Cretaceous?	3000+	FERGUSSON I: Undifferentiated gneiss and schist, mostly quartzofeldspathic; includes some small granitic intrusions	On N Normanby I, some Cu, Pb, and possibly Au mineraliz
			Kurada Metavolcanics (Mk) Cretaceous?	1000+? in Samarai 2000 on Fergusson I	SAMARAI, FERGUSSON I: Metabasalt and basic schist, basalt mylonite, contorted laminated limestone; greenschist facies*	On S Normanby I, originally pile of probably submarine bs and bs tephra with minor lst; submarine in Awaiara Bay; may overlie Prevost Metam
			Prevost Metamorphics (Mp) Cretaceous?	2000 on Fergusson I 1000+ in Samarai	SAMARAI, FERGUSSON I: Layered sequence of chloritic basic schist, calcic schist, and quartz-feldspar-mica schist; greenschist facies	In Samarai, minor alluv Au. On Fergusson I, originally mainly quartzofeldspathic sed with some interbedded lst and basic volc; may underlie Kurada Metavolc

Jurassic - Early Cretaceous

JK^5 (contd)	D'Entrecasteaux Complex	Potai Amphibolite (Mt) Cretaceous?	500-1000	FERGUSSON I: Massive amphibolite; minor ultramafics; amphibolite facies*	On NW Fergusson I and inland Goodenough I, originally stocks of gb with minor ultram; lacks comp layering
		Mebulibuli Metamorphics (Mi) Cretaceous?	600+	FERGUSSON I: Layered sequence of amphibolite, calcic gneiss, and quartzofeldspathic gneiss; amphibolite facies*	On NW and E Fergusson I, N inland Goodenough I, originally basic lava and tuff and calc sed; underlain by Amawa Metam; some Cu, Pb, and possibly Au mineraliz
		Amawa Metamorphics (Ma) Cretaceous?	1000	FERGUSSON I: Layered sequence of quartzofeldspathic gneiss with 10% amphibolite and calcic gneiss; amphibolite facies*	On Goodenough and Fergusson I, layered, originally bedded sed, possibly volcanogenic with bulk comp approximating gd; overlain by Mebulibuli Metam, and underlain by Gudanai Metam
		Gudanai Metamorphics (Mn) Cretaceous?	600+	FERGUSSON I: Quartzofeldspathic gneiss; some amphibolite and calcic gneiss, part migmatite; amphibolite facies	On S Goodenough I and N Fergusson I, lacks layering; originally sed sequence like that which formed Amawa Metam; overlain by Amawa Metam, and intruded by Omara Gd
		Morima Metamorphics (Mr) Cretaceous?	600+	FERGUSSON I: Leucocratic quartzofeldspathic gneiss with consistent layering; amphibolite facies	On S Fergusson I, originally sed sequence with bulk comp approximating leucogd; overlain by Amawa Metam, and intruded by Omara Gd
		Deboyne Metavolcanics (Kl) Mesozoic?		DEBOYNE: Metamorphosed basic volcanics and interbedded fine-grained deep-water sediments invaded by basic and intermediate dykes; metavolcanics uniformly medium to fine, commonly well jointed; interbedded sediments, fine-grained sandstone and siltstone*	In Louisiade Archipelago: Panaete and Panapompom Is of Deboyne Gp (Smith & Pieters, 1969)
		Porphyry Palaeozoic or Mesozoic?		DEBOYNE: Dacitic, andesitic, and feldspar porphyries, and felsites; some granodiorite*	On central and E Misima I (de Keyser, 1961), responsible for mineraliz

JK^5 (contd)	Metagabbro Palaeozoic or Mesozoic?		ROSSEL: Metagabbro and metabasalt: medium to fine, with foliated texture	On NE Rossel I, locally Sudest I (Smith & Pieters, 1969)
	Trondhjemite Palaeozoic or Mesozoic?		DEBOYNE: Trondhjemite	On Misima I (de Keyser, 1961)
	Ultramafics Jurassic-Cretaceous	150	ROSSEL: Pyroxenite, medium-coarse; serpentinite, fine*	On SW Rossel I (Smith & Pieters, 1969), conf on low-grade Calvados Schist
	Calvados Schist (K or Ke) Cretaceous?	600+	ROSSEL: Pelitic siltstone, sandstone, minor conglomerate; lowermost greenschist facies or lower grade*	Au in quartz veins on Sudest, Ylia, and possibly other islands; minor py, chromite, and rare Mn assoc with Au-bearing qtz veins on Sudest I (Smith & Pieters, 1969; Smith, 1973)
Jurassic - Early Cretaceous	Umuna Schist (M/Pzu) Mesozoic?		DEBOYNE: Phyllite; graphitic, mica, quartz, and banded schists	Misima I (de Keyser, 1961)
	St Patrick Limestone (M/Pzs) Mesozoic?	0-33	DEBOYNE: Marble and impure limestone, in places with silica bands (recrystallized chert?) and lenses and bands of sandy limestone	Misima I (de Keyser, 1961)
	Ara Greenschist (M/Psa) Mesozoic?	100-170+	DEBOYNE: Chlorite-albite-epidote-actinolite schist (metamorphosed basic volcanics)	Misima I (de Keyser, 1961)
	Oiatau Gneiss (M/Pzo) Mesozoic?	830+	DEBOYNE: Gneiss and schist; minor amphibolite*	Misima I (de Keyser, 1961)
	Lalama Amphibolite (M/Pzb) Mesozoic?		DEBOYNE: Massive plagioclase amphibolite, foliated amphibolite, banded hornblende gneiss, garnetiferous in part, minor intercalated gneiss	Misima I (de Keyser, 1961)

Units not differentiated, at least in part, from JK^5 on 1:1 000 000 map: In Samarai: Plio Normanby Volc (see Tp^5)

Early Cretaceous	JK	Mb Cretaceous or older		SAMARAI: Gabbro; diopside-hypersthene-bytownite rock, some olivine, hornblende; fine granular texture	On Normanby I, similar to gb of Papuan Ultram Belt
		Gabbro (Mb) Cretaceous?	500?	FERGUSSON I: Gabbro and norite*	On Goodenough I, partly covered by Qg
	In Samarai, JK also includes Plio Mwatebu Sst (see Tp^5) on the 1:1 000 000 map				
Late Triassic? - Early Cretaceous	TT	Ultramafics (Mu) Cretaceous or older	3000 on Fergusson I	FERGUSSON I, SAMARAI: Ultramafics: dunite, hartzburgite, wehrlite, enstatite pyroxenite, websterite*	On Fergusson I, possible source for lateritic Ni, Ni sulphides, Pt, cr, ms, as; fault-bounded blocks intruded by Tpg, Omara Gd, Observation Island Gd; partly covered by Normanby, Goodenough, and Sebutuia Volc. Also present on SW Normanby I

ADELBERT AND FINISTERRE RANGES (6)

Age	1M map unit	Constituent unit(s) in 1:250 000 Sheet areas	Thickness (m)	Lithology	Additional pertinent data
Quaternary	Qa^6	Qa, Qha Holocene (Partly at least included in Qs^6)	600 in lower Markham valley; 200 in Madang	HUON-SAG SAG, NE RAMU, NE BOGIA, KARKAR I, MADANG, MARKHAM: Alluvium and beach deposits: gravel, sand, silt, mud, clay; minor peat, colluvium, soils, swamp deposits; lenticular gravel aquifers	In Madang and Karkar I, gv source of road agg; prospected unsuccessfully for heavy minerals in Astrolabe Bay and on Karkar I
		Qs Quaternary (Partly at least included in $Tmm\text{-}u^6$, Tml^6, Tou^6)	to 200 in Madang	S, W HUON-SAG SAG, S MADANG, BOGIA, SW KARKAR I: Colluvium: chaotic boulder deposits of angular rock fragments	Landslides: mainly debris avalanches, and combination of debris avalanches and large rotational slumps
		Qf, Qphf Holocene-Pleistocene? (Partly at least included in Tp^6)	80+	NW MARKHAM, SW MADANG: Unconsolidated to poorly consolidated pebble, cobble, and boulder gravel, sand, and silt; generally stratified, poorly sorted; coarser in fanhead than in toe	Surface sed Holo, probably Pleist below; piedmont slope sed; lenticular sand and gravel aquifers with clayey gv aquicludes
		Unit not differentiated, at least in part, from Qa^6 on 1:1 000 000 map: In Madang: Quat Wandokai Lst (see Qs^6)			
	Qs^6	Wandokai Limestone (Qw) Quaternary (Partly at least included in Qa^6, Tml^6, Tou^6)	2000 in Huon-Sag Sag; 400 in Bogia; 800 in Madang; 200 in Karkar I	BOGIA, COASTAL HUON-SAG SAG, MADANG, KARKAR I: Massive or crudely bedded, cavernous biocalcirudite, calcarenite, calcilutite, calcareous mudstone, subordinate lithic arenite, conglomerate; subordinate volcanically derived sandstone and conglomerate	In coastal Huon-Sag Sag, fringing and patch reef complex; in NW, unconf on Kabenau Beds, Gusap Arg, Finisterre Volc; on coast N of Finisterre Ra, unconf on Tipsit Lst; in part unconf on, and in part facies equiv of, Timbe R Cgl; corals, algae, bry, biv, gast, larger and smaller foram; corr with lst dated by radiocarbon and Th-230 methods in Huon Pen as

Qs^6 (contd)				greater than 250 x 10^3 to 6 x 10^3 years. In Bogia, interf with and partly overlies Kabenau Beds; dated by plank foram as N21-22 in part. In Huon-Sag Sag, in part unconf on Song R Calcaren and Kabwum Lst Mem. In Madang, unconf on Gusap Arg, Finisterre Volc, Tipsit Lst, and Kabenau Beds; partly overlain by and partly facies equiv of Timbe R Cgl; used for road agg and manufacture of stabilized bricks; aquifer for Madang and coastal villages; potential commercial source of lime; clay used for pottery
Quaternary	Timbe River Conglomerate (Qpt) Pleistocene (Partly at least included in Tp^6)	800 in Madang; 100 in Huon-Sag Sag	MADANG, HUON-SAG SAG: Pebbly sandstone, sandstone, conglomerate; conglomerate very poorly sorted, well rounded; limestone pebbles and cobbles predominate; crudely to evenly bedded	In NW Huon-Sag Sag and coastal S Madang, raised deltas and alluv fans; facies equiv of dated Pleist reefs; overlies Kabwum Lst Mem; grades later into more volc derived parts of Wandokai Lst. In W Madang, unconf on Tipsit Lst, Kabwum Lst Mem; partly conf overlies and partly facies equiv of Wandokai Lst; plank foram indicate N21-22 in part
	Qpg Pleistocene (Partly at least included in $Tmm\text{-}u^6$, Tou^6)	20 in Madang; c.30 in Markham	SE MADANG: Fluvioglacial deposits: poorly sorted crudely bedded gravel, sand, silt, clay	Valley-dammed lakes which received fluvioglacial dep during Pleist glaciation
			MARKHAM: Also boulder beds	
	Qpm Pleistocene (Partly at least included in $Tmm\text{-}u^6$)	10	CENTRAL HUON-SAG SAG, NE MARKHAM: Glacial moraine: unsorted and unconsolidated massive till with limestone clasts	Remnant of Pleist glaciation: terminal glacial moraine. Overlies Gowop Lst

Quaternary	Qs^6 (contd)	Qp Pleistocene	800	NE RAMU, BOGIA: Mudstone, soft, carbonaceous, and shelly, interbedded with friable carbonaceous sandstone and siltstone, partly conglomeratic, grading laterally into chalky limestone	Partly marine. Overlain by fgl and alluv. Contains corals, molluscs, bry
		Qc Quaternary		E, NE HUON-SAG SAG: Raised coral	Fringing reefs
	Units not differentiated, at least in part, from Qs^6 on 1:1 000 000 map: In Bogia:Holo Qa (see Qa^6); and Mio-Pleist Kabenau Beds (see Tp^6)				
Pliocene	Tp^6	Ouba Beds (Tpo) Pliocene	1000-3000	NE RAMU: Mudstone, massive to thinly bedded; interbedded soft mudstone, siltstone, sandstone; minor conglomerate and limestone; pebble, boulder conglomerate, partly calcareous	In places unconf on unnamed Oligo? to e Mio? beds (Tlm). Lowermost cgl beds grade later into richly foss lst with abd corals, bry, and molluscs. Foram common throughout
		Leron Formation (Tpl) m Miocene-l Pliocene-Pleistocene? (Partly included in Tp^4)	to 1000 in Markham; 2000 in Madang; 100 in Huon-Sag Sag	NE MARKHAM: Alternating well bedded sandstone, pebbly sandstone, conglomerate; subordinate siltstone and minor limestone lenses; minor lignite; poorly indurated and generally well sorted	Flanking dep derived from erosion of rising Sarawaged Ra; dep in shallow-water marine and estuarine envir. Probably equiv to Babwaf Cgl; unconf on Mena Beds. Foram in lst lenses; plant remains
				HUON-SAG SAG: Conglomerate with basalt and andesite clasts predominating; crudely bedded and poorly sorted	Unconf on Finisterre Volc. Plio foram
				MADANG: Greywacke, pebbly lithic arenite, conglomerate, some very coarse siltstone, minor limestone; lignite common	In SW Madang, shallow-marine envir of shelf-type which received abd terr detritus from uplifted Finisterre Ra; unconf on Gusap Arg; facies equiv of Kabenau Beds; basal beds contain larger foram dated as Te-e Tf; includes rocks previously described as Mena Beds; grades up into non-marine Qf

Tp^6 (contd)	Tp, Tpi Pliocene (Partly at least included in Tmm-u^6, Tml^6)	100	SW HUON-SAG SAG: Basic volcanics: mainly horizontal flows of basalt with clinopyroxene and olivine phenocrysts*	Horizontal basalt filling depressions between tilted fault blocks. Postdates probable e Plio uplift and block-faulting. Unconf on Tipsit Lst
			BOGIA: Fine-grained dolerite, microdolerite, microtonalite, diorite, granodiorite, gabbro	Intrudes Kabenau Beds
			CENTRAL MADANG: Gabbro, diorite, clinopyroxene diorite, hypersthene gabbro, dolerite, microdiorite, quartz gabbro, tonalite, microtonalite, granophyric differentiates	Intr; limited contact metam, with minor mineraliz of py and ch; intrude Tipsit Lst, Kabwum Lst Mem, Finisterre Volc; intrude Kabwum Lst Mem as stocks, dykes, and sills; evidence of po-type mineraliz
Pliocene-Pleistocene	Uvo Volcanics (Tpu) 1 Pliocene-Pleistocen (At least partly included in Tou^6)	500	E BOGIA: Andesitic agglomerate, lapilli tuff, tuff; agglomerate fine-grained and of high-silica andesite composition	Subaerial volc. Unconf on Finisterre Volc
	Kabenau Beds (Tpk) Miocene-Pleistocene (Partly at least included in Qs^6, Tml^6, Tou^6)	5000 in Madang 3500 in Karkar I	W MADANG, BOGIA, KARKAR I: Well bedded, cross-bedded calcareous lithic arenite, siltstone, mudstone, paraconglomerate (some very coarse); lignite common; interbedded biomicrite (and basaltic to andesitic volcanics in places in Bogia and Karkar I only)	In Madang and Bogia, shallow-marine and deltaic envir which received abd terr detritus; abd plank (N11-N21, 22) and in places benth smaller foram; frag carb plant remains; frag biv; 1 Te-e Tf date obtained from Karkar I. In Bogia, unconf on Finisterre Volc; interf with and in part unconf on Gowop Lst; partly conf below and interf with Wandokai Lst; in SE unconf on Gusap Arg. In Madang, in NW, unconf below Wandokai Lst; elsewhere unconf on Finisterre Volc and unconf below Timbe R Cgl; facies equiv of Leron Fm and Tipsit Lst and Kabwum Lst Mem in part; probably greatest thickness in W Madang; distinguished from Leron Fm by finer and more persistent bedding and better sorting

Units not differentiated, at least in part, from Tp^6 on 1:1 000 000 map: In Huon-Sag Sag: Pleist Timbe R Cgl (see Qs^6). In Madang: e Mio Kwama Bs (see Tou^6). In Markham and Madang: Quat Qf (see Qa^6)

$Tmm\text{-}u^6$	Song River Calcarenite (Tms) Miocene-Pliocene	2800	E HUON-SAG SAG: Calcarenite, well bedded, fine-grained, moderately well sorted, interbedded with calcilutite to E; bedding regular; fine-grained to SE becoming predominantly micritic near Finschhafen; minor lava breccia*	Deep-water marine envir receiving sed from reef complex which also shielded envir from terr detritus; rhythmic local alternations of calcaren and calcilut show beds turbiditic, implying intermittent density currents transporting fine reef detritus into bathyal envir. Interf with Pindiu Sst; to W, changes gradually into largely non-clastic algal-foraminferal biomic of Gowop Lst; unconf on Kabwum Lst Mem; probably gradually thins to E
Middle - late Miocene	Gowop Limestone and Kabwum Limestone Member (Tmgo, Tmgk) e or m Miocene-Pliocene	to 3200 in Huon-Sag Sag; to 1300 in Markham; 1000 in Bogia; member 3500 in Huon-Sag Sag; 2500 in Madang	HUON-SAG SAG, E BOGIA, N, NE MARKHAM: Resistant, crudely bedded, or massive algal-foraminiferal biomicrite; minor calcarenite and calcilutite	In Huon-Sag Sag, reef core of barrier and platform reef complex; unconf on Finisterre Volc in S; partly later equiv of and partly overlain by Kabwum Lst Mem and Song R Calcaren; algae, larger and smaller foram (1 Te-Tg), molluscs, corals. In Markham, unconf on Finisterre Volc; low part complexly interf with Tipsit Lst; grad into Kabwum Lst Mem; contemp with Mebu Beds and Mena Beds; foss similar to those in Huon-Sag Sag. In Bogia, small fringing and barrier reef complex; interf with and partly conf below Kabenau Beds; larger and plank foram indicate 1 Te-e Tf in part
			Member in HUON-SAG SAG, MARKHAM, MADANG: Algal-foraminiferal biomicrite, biocalcirudite, soft well bedded calcarenite, calcilutite; calcareous mudstone at top; biomicrite more porous, slightly less resistant and better bedded than remaining part of Gowop Limestone	In Huon-Sag Sag, fore-reef and reef core of platform reef complex; conf on Tipsit Lst; unconf below Wandokai Lst and Timbe R Cgl; later equiv of much of Gowop Lst farther S; contains plank and larger foram, algae, corals, bry, biv, gast; algal-foram biomic contains larger foram of 1 Te to e Tf age;

	$Tmm\text{-}u^6$ (contd)			calc mdst contains plank foram of N9 to N18-N22 age. In Markham, grad from Gowop Lst; conf on Tipsit Lst; contains larger and plank foram, algae, corals, molluscs. In Madang, conf on Tipsit Lst; unconf below Wandokai Lst and Timbe R Cgl; partly facies equiv of Kabenau Beds and Leron Fm; thins to S and W; base dated by larger foram from algal-foram biomic as 1 Te-e Tf; calc mdst with plank foram of N18-N21 age at top of fm; suitable as source of lime
Middle - late Miocene	<u>Tipsit Limestone</u> (Tmp) 1 Oligocene-m Miocene (At least partly included in Tou^6)	500 in Huon-Sag Sag; 1000 in Madang	HUON-SAG SAG: Soft micritic limestone, biomicrite, calcilutite, lignite, calcareous shale; silt and fine sandstone at base; some calcarenite with limestone and organic fragments in micritic groundmass; paraconglomerate at base in places	Restricted lagoonal envir which received terr detritus, changing with time into open back-reef envir shielded from terr detritus. Wedges abruptly to N; conf below Kabwum Lst Mem; in part conf on Kwama Bs. Contains sponges, biv, gast, frag plant remains; plank and larger foram indicate e-m Mio
			MARKHAM: Also lignitic and calcareous shale; siltstone and fine-grained sandstone at base	Grad over Kwama Bs; complex interf with low part of Gowop Lst; conf below Kabwum Lst Mem; dated by foram as 1 Te (e Mio)
			MADANG: Also calcareous conglomerate near base in places	Unconf on Finisterre Volc; conf below Kabwum Lst Mem; on coast, unconf below Timbe R Cgl; facies equiv in part of Kabenau Beds; wedges abruptly to NE; thins gradually to W. Dated by foram as 1 Oligocene-e or m? Mio

Units not differentiated, at least in part, from $Tmm\text{-}u^6$ on 1:1 000 000 map: In Huon-Sag Sag and Madang: Quat Qs (see Qa^6); and e Mio, 1 Oligo Kwama Bs and e Oligo-e Mio Finisterre Volc (see Tou^6). In Madang and Markham: Pleist Qpg (see Qs^6); and e Mio, 1 Oligo Kwama Bs (see Tou^6). In Huon Sag Sag: Pleist Qpm (see Qs^6)

	Tml^6	Ts (Unnamed intrusives) e Miocene? (At least partly included in Tou^6)		NE MARKHAM: Gabbro, andesite porphyry, diorite	Intrudes Mebu Beds and Finisterre Volc. Commonly py; minor Cu mineraliz
		Mena Beds (Tml) e-m Miocene		NE MARKHAM: Interbedded micaceous sandstone, greywacke, lithic siltstone, conglomerate, minor limestone lenses	Geosynclinal sed in S part of Northern New Guinea Basin; clastic sed contemp with part of Gowop Lst. Probably unconf on Mebu Beds; unconf below Leron Fm. Contains foram and plant remains
Early Miocene		Pindiu Sandstone (Tmq) e-m Miocene (At least partly included in Tou^6)	5000	E CENTRAL HUON-SAG SAG: Well bedded, poorly sorted tuffaceous and in places carbonaceous sandstone and siltstone; fine to coarse, with argillaceous matrix	Deep-water marine envir which received turbiditic sed from volc source area to SW. Up part of Finisterre Volc probably up-slope later equiv of Pindiu Sst; conf below Song R Calcaren and Gowop Lst; probably conf on low part of Finisterre Volc. Plank foram (1 Te-e Tf) and carbon plant remains

Units not differentiated, at least in part, from Tml^6 on 1:1 000 000 map: In Bogia: Quat Qs (see Qa^6); Quat Wandokai Lst (see Qs^6); and Plio Tp (see Tp^6). In Karkar: Mio-Pleist? Kabenau Beds (see Tp^6). In Ramu: Oligo?-e Mio? Tlm (see Tou^6)

Late Oligocene	Tou	Tu Tertiary or older (from early report, substantiated by neither private mining company investigation nor recent regional mapping)		W HUON-SAG SAG: Ultrabasic intrusions: coarse, even-grained peridotite and serpentinized peridotite	Small intr; seem to intrude Finisterre Volc and Tipsit Lst

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Late Oligocene	Tou^6	Kwama Basalt (Tmk, Tofk) e Miocene, 1 Oligocene (Partly at least included in Tp^6,	500 in Madang; 150 in Huon-Sag Sag	N HUON-SAG SAG, E MADANG, MARKHAM: Basaltic lava, generally much less brecciated than Finisterre Volcanics; porphyritic basalt*	In Huon-Sag Sag and Madang, flat-lying submarine platform which received series of lava flows; up part interf with Tipsit Lst; in S, complex interf relat with both Gowop Lst and Tipsit Lst; in N conf overlain by Kabwum Lst

Tou[6] (contd) Tmm-u[6])			Mem and Tipsit Lst; probably conf on Finisterre Volc in S, Pindiu Sst in N; Mio age. Also present in Markham, but of Oligo age and termed Kwama Volc Mem of Finisterre Volc on N side of Saruwaged Ra
Mebu Beds (Tom) 1 Oligocene-m Miocene		NE MARKHAM: Greywacke, argillite, basaltic-andesitic volcanolithic conglomerate; minor basaltic lava, pyroclastics, limestone lenses; rocks strongly indurated, veined, sheared	Dep in course of geosynclinal clastic sedimentation in S part of Northern New Guinea Basin. Unconf on Finisterre Volc; probably unconf below Mena Beds; intruded by unnamed e Mio minor intr; contemp with Tipsit Lst and low part of Gowop Lst. Contains foram
Tlm Oligocene?-e Miocene? (Partly at least included in Tml[6])	1000+?	E RAMU: Well indurated sandstone, siltstone, mudstone, conglomerate, massive agglomerate; quartz and calcite veins	Struc complex: mainly fault-bounded blocks. Generally unfoss. Regarded as basement to petrol prospective sed of Ramu Basin
Late Oligocene			
Finisterre Volcanics (Tof) e Oligocene-e Miocene (1 Oligocene in Markham) (Partly at least included in Tmu, Tmm-u[6])	5500 in Huon Sag Sag; 2500-5000 in Madang; 4500 in Karkar I; 5000 in Bogia	S, NW MADANG, SE BOGIA, W HUON-SAG SAG, KARKAR I, NE MARKHAM: Basaltic and andesitic flow breccia, indurated tuffaceous lithic greywacke, lithic and crystal tuff, paraconglomerate, peperite and peperitic breccia, palagonite breccia, lava, pillow lava, pillow breccia; minor agglomerate, argillite, limestone lenses	In Huon-Sag Sag, submarine volcanoes and slopes with volcanolithic sed, rubble slides, paracgl, and assoc turbidite dep; conf below Gowop Lst in S-centre and Kwama Bs in N; interf with Pindiu Sst in N; possibly conf below Song R Calcaren in E; probably up part interf with and partly conf below Pindiu Sst. In Markham, inferred to be conf below Kwama Bs; unconf below Gowop Lst and Mebu Beds; intruded by unnamed e Mio minor intr; conf on Gusap Arg; in E, unconf below Tipsit Lst and Kabwum Lst Mem; in W, unconf below Kabenau Beds, Leron Fm, Wandokai Lst; contains larger foram and algae; dated by K-Ar method at 34.4 ± 1 m.y. to 24.1 ± 0.7 m.y.
Gusap Argillite (Teg) Eocene	5000 in Madang and Bogia	W MADANG, SW BOGIA, (KARKAR I, section only): Indurated, strongly jointed, veined cherty argillite, chert beds, tuffaceous lithic greywacke, lithic	Deep, probably fault-bounded trough and steep submarine slope which received at first fine terr detritus and plank foram, and later coarser volc detritus, lava flows, and tuff.

Late Oligocene	Tou^6 (contd)	greywacke; subordinate basalt and andesite flow breccia, pillow lava, lava, volcanic breccia, dolerite and microdiorite dykes, lithic and crystal tuff, cherty micritic limestone, para-conglomerate	May overlie oceanic crust; grades up into Finisterre Volc; unconf below Leron Fm in SW, Kabenau Beds and Wandokai Lst in NW; probably thins gradually to N. Dated by plank foram and nannoplank (P12-14). Grades into Finisterre Volc indicating that either Teg extends into e Oligo or Finnisterre Volc extend into l Eo; lithological similarity with Goroka Fm, which may be older, deeper level, more metam equiv; possibility of continuous dep of Goroka Fm thr-ough to Teg, i.e., Teg may range to Cret or Goroka Fm (see Region 3) may be E Tert in part

Units not differentiated, at least in part, from Tou^6 on 1:1 000 000 map: In Karkar I: Quat Wandokai Lst (see Qs^6). In Huon-Sag Sag: Pleist Qs (see Qa^6); e-m Mio Tipsit Lst (see $Tmm\text{-}u^6$); and e-m Mio Pindiu Sst (see Tml^6). In Markham: Pleist Qpg (see Qs^6); and e Mio? Ts (see Tml^6). In Bogia: Plio-Pleist Uvo Volc (see Tp^6). In Bogia, Karkar I, Madang: Mio-Pleist Kabenau Beds (see Tp^6)

NEW BRITAIN (7)

	Age	1M map unit	Constituent unit(s) in 1:250 000 Sheet areas	Thickness (m)	Lithology	Additional pertinent data
		Qa^7	Qa, Qab (At least partly included in Qs^7)	to 500	POMIO, N and S TALASEA-GASMATA, N and S CAPE RAOULT-ARAWE, GAZELLE PENINSULA: Alluvium and beach sand: gravel, sand, silt, clay (Qa). Fanglomerate and raised boulder beds: gravel, sand, silt, mud; poorly consolidated (Qab)	Qab in Gazelle Pen only. In Pomio, Talasea-Gasmata, and Cape Raoult-Arawe, mainly Holo but probably includes some Pleist sed; boundaries with Kimbe Volc, Qc, and Cape Gloucester Volc poorly defined, grad and arbitrary in some areas; in places source of road metal and concrete agg. In Gazelle Pen, minor alluv Au; mt beach sands under investigation; gv used for road-making and agg; overlies Sai Beds and forms discontinuous capping on Ti (Toi); plant remains and some molluscs
Quaternary		Qv^7	Qv Quaternary	to 100	NE MADANG, KARKAR I, BOGIA: Tholeiitic basalt and andesitic pyroclastics; highly porphyritic; agglomerate, tuff, ash, reworked*	In Madang, strat relat unknown; subaerial volc, largely explosive; reworking of pyroclastics; part of active Bismarck Volcanic Arc
			Qav Holocene (Not mapped in detail)	to 100	N, NE GAZELLE PENINSULA: Volcanolithic gravel, sand, silt, minor primary ash; some current-bedding	Reworked volc ejectamenta from Rabaul eruptive centres
					SAG SAG, MADANG, KARKAR I, BOGIA, SEPIK: Basalts, low- and high-silica andesites, very rare dacites; mostly highly porphyritic*	Westernmost New Britain, and offshore islands of northern mainland: Umboi, Ritter, Tolokiwa, Sakar, Siassi, Long, Crown, Bagabag, Karkar, Manam, Aris, Bam, and all remaining Schouten Is (Johnson, Taylor, & Davies, 1972)

Qv^7 (contd)	Kimbe Volcanics (Qk) Pleistocene-Holocene	to 1200 in Cape Raoult-Arawe; to 2500 in Talasea-Gasmata; to 3000 in Gazelle Peninsula	NW CAPE RAOULT-ARAWE, TALASEA-GASMATA, SW GAZELLE PENINSULA: Andesitic, dacitic, rhyolitic, and basaltic lava, pyroclastics, reworked pyroclastics; principally ash, lapilli, scoria, rubble; minor obsidian; high-level hypabyssals; superficial ash and pumice	Include all volcanoes and their products between Likuruanga and Willaumez Pen. In Cape Raoult-Arawe, potential source of good-quality crushed agg. In Talasea-Gasmata, includes all volc and assoc material on N coast; youngest rocks erupted from Mt Ulawun in 1970; S on Mt Bamus, Pago, and Garbuna. In Gazelle Pen, some S in crater of Mt Lolobau
	Cape Gloucester and Andewa Volcanic Complexes and Rabaul Volcanics (Qg, Qs, Qv) Pleistocene-Holocene	to 2000 in Cape Raoult-Arawe; 1000-5000 in Gazelle Peninsula	NW CAPE RAOULT-ARAWE, GAZELLE PENINSULA: Basaltic, andesitic, dacitic lava, pyroclastics, reworked pyroclastics; andesitic porphyry, microdiorite	In Cape Raoult-Arawe, bulk of complexes occurs W of area as product of Tangi and Talawe volcanoes; volcanoes probably Pleist as inferred from degree of dissection, but young cones present in places; overlie Aria Beds; potential local source of good-quality crushed agg. In Gazelle Pen, volc ejectamenta of Rabaul Volc from Rabaul eruptive centres from NE lowland; also eruptive centre at Watom I; pumice may be suitable for use as lightweight concrete agg

Quaternary

Qs^7	Qc, Qpc Pliocene?, Quaternary	to 300; 50-100 in Gazelle Peninsula	S TALASEA-GASMATA, S POMIO, S CAPE RAOULT-ARAWE, S, E GAZELLE PENINSULA: Raised coral: porous coral bioherms; mostly not crystallized; calcarenite, calcirudite, calcareous mudstone, siltstone, sandstone, conglomerate; marl beach rock	Includes all reefs and lagoonal sed elevated above high-tide level; possibly as old as Plio in places; source of road and airstrip surfacing material (coronous) and lime
	Ip Beds (Qpi) Pleistocene-Holocene	to 400	POMIO: Semiconsolidated conglomerate, sandstone, siltstone; minor sandstone with molluscs; clasts include Baining Volc, unnamed plutonics, Yalam Lst	Fluv and marine; overlain by Qc; dep along fault; equiv to Qab in Sai R (Gazelle Pen); dated by plank foram (N22-23)

Quaternary	Qs^7 (contd)	Riet Beds (Qpr) Pleistocene-Holocene	300-500	GAZELLE PENINSULA: Fluvial conglomerate, sandstone, mudstone; partly tuffaceous; some current-bedding	Formed by erosion of Baining Mtns, with some volc ejecta higher in section; single C^{14} date of 50 000 years; some bs dykes and sills; unconf on Sinewit Fm and Meulo Volc; conf and disconf below Rabaul Volc
	In Pomio, Qs^7 also includes some Qa (see Qa^7)				
Late Pliocene	Tp^7	Johanna Beds (Tpj) Pliocene and younger (At least partly included in Tm^7)	to 200	CAPE RAOULT-ARAWE, SW TALASEA-GASMATA: Soft calcareous siltstone, sandstone, mudstone, conglomerate; limestone and shelly pumiceous siltstone	Pumiceous detritus suggests equiv to Kapiura Beds; unconf on Baining Volc, Kapuluk Volc, Yalam Lst; overlies and equiv in part to Aria Beds; overlain by and partly equiv to Qc, possibly extending into Pleist. Dated by plank foram (N19-21)
		Aria Beds (Tpa) Pliocene	to 500	CAPE RAOULT-ARAWE: Semiconsolidated marine volcanolithic sandstone, siltstone, mudstone, conglomerate; calcareous in part	Overlie Yalam Lst and overlain by Andewa Volc Comp and Johanna Beds; probably equiv to Johanna Beds. Dated by plank foram (N19-21)
		Sai Beds (Tps) 1 Miocene-Pliocene (Talasea-Gasmata) Pliocene (Pomio, Gazelle Peninsula)	150-500	N POMIO, S GAZELLE PENINSULA, TALASEA-GASMATA: Soft calcareous mudstone and siltstone; limestone lenses and interbeds. Locally in Gazelle Peninsula some sandy (tuffaceous?) interbeds in mudstone; coral-biohermal and bioclastic limestone lenses	In Pomio, overlie Baining Volc, Merai Volc, Yalam Lst, Sinewit Fm; dated by plank foram. In Gazelle Pen, later equiv of Lakit Lst and possibly of up part of Sinewit Fm; unconf below Qab; dated by foram (N19 and e N20); molluscs also present. In Talasea-Gasmata dated at N17-19
		Lakit Limestone (Tpl) Pliocene	200-300	GAZELLE PENINSULA: Bioclastic limestone; poorly consolidated; soft clayey calcareous matrix	Later equiv of Sai Beds; probably slight angular unconf on Sinewit Fm. Algal, coral, bry, and molluscan debris. Dated by foram. Possible commercial source of lime

Tmu-p[7]	Penk Volcanic Complex (Tpp) Pliocene? (At least in part included in Tou[7])	to 300	CAPE RAOULT-ARAWE: Acid and intermediate pyroclastics and lava; porphyritic dacite or rhyolite plugs; volcanolithic conglomerate	Volc hbl-bearing. Possibly Plio on ground of preservation. Overlies Kapuluk Volc and marl facies of Yalam Lst
	Kapiura Beds (Tpk) Pliocene	to 450	CENTRAL W TALASEA-GASMATA: Semiconsolidated massive to well-bedded and tuffaceous sandstone, siltstone, conglomerate, tuff, volcanolithic conglomerate; minor limestone and calcareous sediments	Acid volc source indicated by abd qtz and pumice grains; similar to Sinewit Fm in Gazelle Pen. Unconf on Baining Volc, Kapuluk Volc, unnamed plutonic rocks, Yalam Lst; underlie Kimbe Volc. Age inferred from uplift, dissection, and unconf on Yalam Lst
Late Miocene - early Pliocene	Mungu Volcanics (Tpm) Pliocene	to 450	W TALASEA-GASMATA: Dacite, rhyodacite, andesite, pumiceous tuff	Probable source of volc detritus in Kapiura Beds; may interf with Kapiura Beds; age inferred from degree of dissection
	Toki Andesite (Tpt) Pliocene (At least in part included in Tm[7])		NW TALASEA-GASMATA: Porphyritic hornblende andesite and microdiorite	Plio on grounds of preservation and probable intr relat with Sai Beds. Contains hbl, unlike Kimbe Volc ad
	Sigule Volcanics (Tmps) 1 Miocene-Pliocene	500-1000	E GAZELLE PENINSULA: Thick-bedded subaerial basaltic and andesitic lava, agglomerate, tuff; minor marine calcareous tuff	Underlain by Merai Volc; overlain by raised coral and Rabaul Volc. Dated by foram which are similar in Sinewit Fm (later equiv)
	Sinewit Formation and Mevlo Volcanic Member (Tmpi, Tmm) 1 Miocene-Pliocene	500-1000 in Gazelle Peninsula; to 500 in Pomio, member 200?	NE POMIO, GAZELLE PENINSULA: Semiconsolidated marine and fluviatile tuffaceous arenite and lutite derived from acid and intermediate volcanic rocks; minor conglomerate, some limestone. In Gazelle Peninsula, also some rare thin lignite beds and calcareous facies;	In Pomio, unconf on Merai Volc; dated by foram. In Gazelle Pen, source of all clastics; contemp volc probably centred in Sigule Volc area; later equiv of Sigule Volc; unconf on Baining Volc, Ti, Merai Volc, Yalam Lst; conf on Mevlo Volc Mem; overlain by Lakit Lst and unconf by Riet Beds; dated by foram; thin local interbeds

Tmu-p[7] (contd)			dacitic and andesitic glassy lavas and ash-flow tuffs with some pumiceous semiwelded tuffs separated as member Tmm	of lignite probably too small for commercial dev. Mem only in Gazelle Pen; possibly represents final stage of eruption of Nengmukta Fm; unconf on Baining Volc and (or possibly intruded by) Ti; may be conf on Nengmukta Fm; conf below Sinewit Fm; 1 Mio age
Late Miocene - early Pliocene	Esis Beds (Tmpe) 1 Miocene-Pliocene	to 600	POMIO: Well bedded to massive soft calcareous shale and siltstone; interbedded subordinate soft porous limestone (chalk)	Overlies Yalam Lst; probable part later equiv of Sinewit Fm m and Sai Beds. Dated as N18-19 by plank foram
	Nengmukta Formation (Tmn) 1 Miocene (At least in part included in Teu[7])	300-500	GAZELLE PENINSULA: Volcanic arenite and lutite with volcanic conglomerate interbeds; some fine carbonaceous interbeds, rare nodules and lenses of fine limestone; arenite and lutite show graded bedding and soft sediment deformation	Source subaerial or shallow-marine explosive eruptions; volc detritus partly redistributed by t.c. Unconf on Baining Volc; may be conf below Mevlo Volc Mem; unconf below Riet Beds. No foss evidence of age; probably earliest 1 Mio
Tm[7]	Yalam Limestone (Tmy) Miocene	to 500 in Cape Raoult-Arawe; to 1300 in Talasea-Gasmata, Pomio; 1000-1200 in Gazelle Peninsula	E CAPE RAOULT-ARAWE, W POMIO, TALASEA-GASMATA, NW GAZELLE PENINSULA: Compact to porous, massive to well bedded, coralgal limestone; massive to well bedded calcarenite, calcilutite, minor calcirudite; soft calcareous siltstone, sandstone, and mudstone, with interbedded chalky limestone. In NW Gazelle Peninsula, rare calcareous sandstone and conglomerate at base; limestone partly recrystallized and dolomitized	In Cape Raoult-Arawe, overlies Kapuluk Volc, and overlain by Penk Volc Comp, Aria Beds, Johanna Beds; dated by larger and smaller foram as 1 Te and e, 1 Tf; potential source of pure lime. In Pomio, dated by larger foram as Tf, some 1 Te. In Talasea-Gasmata, unconf on Baining Volc, Merai Volc, Kapuluk Volc, Toi; potential source of pure lst; dated 1 Te-Tf by foram. In Gazelle Pen, deposited in shallow water during long gradual subsidence with no volc and no nearby eroding landmass; unconf on Baining Volc, Ti, Merai Volc; unconf below Sinewit Fm; only low part dated by foram; contains algae, corals, bry, molluscs
Early - middle Miocene				

Units not differentiated, at least in part, from Tm[7] on 1:1 000 000 map: In Talasea-Gasmata: 1 Oligo Merai Volc (see Tou[7]). In Cape Raoult-Arawe: Plio Johanna Beds (see Tp[7]). In Talasea-Gasmata: Plio Toki Ad (see Tmu-p[7]). In Pomio: 1 Mio-Plio Esis Beds (see Tmu-p[7])

	Tou[7]	Kapuluk Volcanics (Tok) 1 Oligocene	to 1500	E CAPE RAOULT-ARAWE, TALASEA-GASMATA: Massive to well bedded moderately indurated volcanic breccia, tuff, lapilli tuff, volcanic sandstone, siltstone, conglomerate; volcanics are basaltic to dacitic; minor limestone*	In Cape Raoult-Arawe, less indurated and jointed than Baining Volc; overlie Baining Volc, and overlain by Yalam Lst and Penk Volc; dated by larger and smaller foram as e Te. In Talasea-Gasmata, probably partly terr and partly marine; less indurated and jointed than Baining Volc
Late Oligocene		Merai Volcanics (Tom) 1 Oligocene (At least in part included in Tm[7])	to 1000	N, CENTRAL POMIO, S GAZELLE PENINSULA, TALASEA-GASMATA: Massive to well bedded, moderately indurated volcanic conglomerate and breccia, volcanic arenite, tuff; minor lutite and basic lava POMIO: Zeolite alteration common; carbonate detritus and impure limestone abundant locally GAZELLE PENINSULA: Also includes carbonate debris and rare thin beds of bioclastic limestone; some fine-grained dykes and sills; volcanic material mostly andesitic TALASEA-GASMATA: Also some minor basaltic lava and limestone	In Pomio, generally less indurated, jointed, and faulted than Baining Volc, which they overlie unconf; dated by larger foram (e Te); thin, poor coal seams reported from one locality. In S Gazelle Pen, also less strongly indurated, jointed, sheared, and more carbonate debris than Baining Volc; source: contemp volc partly submarine, some erosion of emergent Baining Volc, and shoal and reef lst; unconf on Baining Volc and probably most Ti; unconf below Yalam Lst, Sinewit Fm, Sigule Volc; dated by foram as e Te. In Talasea-Gasmata, equiv but geographically distinct from Kapuluk Volc, less indurated, jointed, and folded than Baining Volc; unconf on Baining Volc

Unit not differentiated, at least in part, from Tou[7] on 1:1 000 000 map: In Cape Raoult-Arawe: Plio? Penk Volc Comp (see Tmu-p[7])

Late Oligocene	Tou	Intrusives (Toi, Ti) 1 Oligocene (Toi in Cape Raoult-Arawe, Pomio, Talasea-Gasmata) 1 Eocene-Miocene (Ti in Gazelle Peninsula)		E CAPE RAOULT-ARAWE: Intrusive-extrusive complex of rhyolite, dacite, andesite, tuff; rhyodacite porphyry	Exhibit intr relat with surrounding Baining Volc?, but may also be partly eruptive; probably related to 1 Oligo plutonic rocks of Kori R pluton
				POMIO: Tonalite, gabbro, diorite, granodiorite, and adamellite; related	Probably intr equiv of Merai Volc; intrude Baining Volc; 24.3-28.5 m.y. old by K-Ar

	Tou (cont'd)		porphyries and microplutonic rocks	method. Disseminated py common; ch from stream boulders N of Sheet area
			W TALASEA-GASMATA: As in POMIO but also some monzonite and mangerite; intrusive breccias and pyroclastic rocks	Probable intr equiv of Merai Volc and Kapuluk Volc. Unconf below Yalam Lst and Kapiura Beds. Igneous brec and pyroclastics from intr bodies. 22.0-28.7 m.y. old by K-Ar method; po mineraliz at Plesyumi, Kulu River, Uasilau
Late Oligocene			CENTRAL GAZELLE PENINSULA: Leucogabbro, dolerite, basic diorite, diorite, microdiorite, tonalite, granodiorite, monzonite, adamellite	Mostly Oligo, some comagmatic with Baining Volc. some definite Mio (14 m.y. old by K-Ar method), some may be comagmatic with base of Sinewit Fm. Intermediate and acid calcalkaline in N Baining Mtns; high-K calcalkaline in central and S Baining Mtns. Prospective for po Cu-type mineraliz; Cu and Mo sulphides in dr; some Cu-Pb-Zn sulphide in contact zones; Cu sulphides in outcrop and boulders; Fe ore in contact zone at one locality. Au in quartz veins assoc with Ti
Late Eocene	Teu^7	Baining Volcanics (Teb) 1 Eocene	2000+ in most areas	E CAPE RAOULT-ARAWE: Massive, indurated strongly jointed basaltic and andesite lava, agglomerate, volcanic breccia, tuff; minor recrystallized limestone Probably underlie younger rocks throughout much of New Britain; overlain by Kapuluk Volc, and intruded by Ti?
				E POMIO: As above, but also some volcanogenic arenite and lutite; limestone lenses rare May intrude Merai Volc in places. More indurated, jointed, and sheared than Merai Volc. Carbonate detritus uncommon. Slight metam apparent in many areas, with alteration to ep and chl. Py common. Base not exposed; older rocks unknown. Dated by larger foram (Tb)

Late Eocene	Teu^7 (contd)	CENTRAL, SW, W TALASEA-GASMATA: Also some intermediate lavas and hypabyssal rocks	Py common. Base not exposed. More indurated, jointed, and sheared than Merai and Kapuluk Volc. Carbonate detritus uncommon. Slight metam apparent in many areas with alteration to ep and chl. Dated by foram, but no dates from W of 150°47'
		GAZELLE PENINSULA: As above but lava flows rare; rare limestone clasts in volcaniclastic rocks; volcanic material mostly andesitic; some hornfels near intrusives; biotite and hornblende schist in narrow zone	Core of Gazelle Pen. Source: explosive ad submarine volc. Some redistribution of volc debris by slumping and t.c. Intruded by Ti; unconf below Merai Volc, Yalam Lst, Nengmukta Fm, Mevlo Volc Mem, Sinewit Fm, probably Sigule Volc, Riet Beds, raised coral. Dated by foram in volc clasts. Iron ore and some Cu-Pb-Zn sulphide in former lst and slst of Teb at contact with Ti near Rangavere (N Baining coast)

Unit not differentiated, at least in part, from Teu^7 on 1:1 000 000 map: In Gazelle Peninsula: 1 Mio Nengmukta Fm (see $Tmu\text{-}p^7$)

BOUGAINVILLE AND NEW IRELAND (8)

Age	1M map unit	Constituent unit(s) in 1:250 000 Sheet areas	Thickness (m)	Lithology	Additional pertinent data
	Qa[8]	Q, Qh Quaternary	300+ on Bougainville	BOUGAINVILLE I N,S, NEW IRELAND: Silt, sand, gravel, coral	On Bougainville, derived mainly from volc material, and partly from organic material; also air-fall ash dep; unconf veneer on hills of older dep. In New Ireland (Hohnen, in prep.), in places alluv overlaps raised coral
Quaternary	Qv[8]	BOUGAINVILLE GROUP: Tore, Balbi, Bagana, Billy Mitchell, Numa Numa, Reini, Bakanovi, Takuan, and Taroka Volcanics, Emperor Range Volcanic Beds (Czo, Czb, Czg, Czm, Czn, Czr, Czk, Czt, Czl, Cze) Pliocene, Pleistocene, Holocene	460-2135	BOUGAINVILLE I N,S: Andesitic lava, agglomerate, tuff, derived fan deposits; locally basaltic lava	Mainly products of individual stratovolcanoes; some not assigned to specific centres, but others derived from more than one centre; some as old as Plio but most others younger; some still active or semi-active. Tore Volc overlie Emperor Range Volc Beds and abut against Balbi Volc. Balbi Volc unconf on Emperor Range Volc Beds, unnamed volc (Czu), Keriaka Lst; abut against Tore, Numa Numa Volc. Bagana Volc unconf on Kieta Volc, Czu, Billy Mitchell Volc; abut against Reini Volc. Billy Mitchell Volc unconf on Czu, Kieta, Numa Numa, Reini Volc; unconf below Bagana Volc. Numa Numa Volc overlain by Billy Mitchell, Reini Volc; unconf on Kieta Volc; abut against Bagana Volc. Bakanovi Volc unconf on Keriaka Lst, Kieta Volc. Takuan Volc unconf on Kieta Volc; interf with Taroka Volc. Taroka Volc unconf on Kieta Volc. Emperor Range Volc Beds unconf below Tore, Balbi Volc; abut against Sohano Lst; intruded by dr

Quaternary	Qs[8]	Qc Holocene		S NEW IRELAND: Raised coral reefs, coarsely or finely laminated	Back-reef facies made up of Tridacna, foram tests, colonial corals in situ along margins, and locally oolites; offlapping coral terraces at many levels (Hohnen, in prep.)
		Sohano Limestone (Qs) e Miocene?-Pleistocene	90	BOUGAINVILLE I N: Elevated reef complex of massive coralline and shelly limestone	Unconf on Buka Fm; abuts against Emperor Range Volc Beds. Pleist because of little dissection. Rich fauna of corals, algae, molluscs, bry, echino spines, and foram
		Maton Conglomerate (Czm) Pleistocene-Holocene	200-300	S NEW IRELAND: Coarse, current-bedded, cobble and boulder conglomerate and interbedded pebbly sandstone; well sorted, well rounded fragments of Jaulu Volcanics in sand matrix	Probably fgl deposits reworked locally by wave action. Unconf on Jaulu Volc, Rataman Fm, Punam and Surker Lst; unconf below Quat coral terraces (Hohnen, in prep.)
		Uluputur Beds (Czu) l? Pleistocene	c.100	NEW IRELAND: Finely bedded calcareous cobble and boulder conglomerate with clasts of tuff and volcanolithic arenite and lutite, overlain by coquinoid lithic sandstone which passes upwards into alternating siltstone and lithic coquinoid sandstone	Inner neritic facies dep on Rataman Fm in small, shallow embayments in coastline. Abuts against and forms restricted embayments in Punam Lst, which may be coeval in part; unconf on Rataman Fm in type section. Abd molluscan fauna (Honhen, in prep.)
		Punam Limestone (Czp) Pliocene or younger	200-1000	NEW IRELAND: Finely bedded, friable, moderately recrystallized chalky calcarenite; coral-rich facies locally	Unconf on Rataman Fm and Jaulu Volc. Abd foram (Hohnen, in prep.)
Pliocene-Quaternary	TpQp	Diorite (Czd) Oligocene?-Pleistocene?		BOUGAINVILLE I N,S: Microdiorite, diorite, monzonite, granodiorite, syenite, granophyre	Intrudes Kieta Volc, Czu, Emperor Range Volc Beds. Assoc with Au and Cu mineraliz of probable Oligo and e Mio age; main Cu ores ch, bornite, ml on weathered surfaces; ore reserves at Panguna Cu mine 890 000 000 tonnes of 0.47% Cu ore and 0.54 g/tonne of Au (as at Dec 1973)

Miocene - Pliocene	Tm-p[8]	Lelet Limestone (Tmpl) le Miocene-Pliocene-Pleistocene?	to 1400	NEW IRELAND: Coral and algal biostromal calcarenite, calcirudite, minor foraminiferal biomicrite; limestone completely recrystallized at base and only slightly at top	Probably dep on igneous 'basement' of elongated volc islands. Unconf on Jaulu Volc and Lemau Intr Comp, and conf on Lossuk R Beds; partly abuts against and partly equiv to Rataman Fm; probably partly equiv to Surker Lst. Corals and algae abd; some foram (Hohnen, in prep.)
		Lossuk River Beds (Tml) e Miocene	c.150 at type section	NW NEW IRELAND: Finely laminated siltstone, well cemented angular calcirudite, pebbly feldspathic labile sandstone, conglomerate	Unconf on Jaulu Volc from which largely derived; overlain, apparently conf, by Mio parts of Lelet Lst. Dated by pelagic foram; corals, algae, biv locally (Hohnen, in prep.)
Late Miocene - late Pliocene	Tmu-p[8]	Rataman Formation (Tmr) l Miocene-e Pliocene	c.500	NEW IRELAND: Poorly lithified ash-fall andesitic and dacitic tuff, volcanolithic arenite and lutite, and foram marl and limestone; small local lenses of coal and conglomerate	Dep in course of radical changes in conditions of bottom envir. Overlies Jaulu Volc and Surker Lst with high-angle unconf; locally unconf below Punam Lst and Uluputur Beds. Abd corals, molluscs, and foram (Hohnen, in prep.)
Early Miocene	Tml[8]	Surker Limestone (Tms) e Miocene	c.500 in type section, thickens to 1300 in S?	S NEW IRELAND: Lepidocyclina chalk, clayey calcarenite, calcirudite; minor arenaceous limestone with rare calcareous volcanolithic sandstone	Unconf on Jaulu Volc and Lemau Intr Comp; abuts against Rataman Fm in N and E. Foram (Te) and biv (Hohnen, in prep.)
		Keriaka Limestone (Tl) e Miocene	1200+	BOUGAINVILLE I N,S: Foraminiferal, shelly, coralline, and algal limestone	Uplifted reef complex. Unconf on Kieta Volc; unconf below Bakanovi, Billy Mitchell, Numa Numa, and Balbi Volc. Rich algae; some bry, corals, molluscs, dateable foram (Te)

Late Oligocene	Tou	Lemau Intrusive Complex (Toma, Tomb) e-m Oligocene		NEW IRELAND: Gabbro, norite, diorite, tonalite, trondhjemite, granodiorite, leucocratic dyke rocks; gabbro and norite - in places alkali-metasomatized, and in places with igneous flow-foliation	Discontinuous along length of island as dykes and stocks in Jaulu Volc; abd volc xenoliths. Overlain by e Mio part of Lelet Lst. Finely dissem and vein-forming py abd. K-Ar ages 17.5 ± 0.6 m.y., 13.8 ± 0.5 m.y. (po rhyodacite); 31.8 ± 1.0 m.y. (Hohnen, in prep.)
	To^8	Czu Miocene?-Pliocene?		BOUGAINVILLE I N,S: Andesitic, basaltic, and dacitic lava, tuff, agglomerate	Unconf below Balbi, Numa Numa, Billy Mitchell, Bagana Volc; intruded by dr; may be equiv to Kieta Volc on location, geomorphology, and petrography
		Buka Formation (Tb) Oligocene?-e Miocene	490+	BOUGAINVILLE I N: Well bedded sandstone and siltstone composed of volcanic material and locally cross-bedded, graded-bedded and with slump structures; tuff, agglomerate, basaltic lava	Unconf below Sohano Lst. Age uncertain but thought similar to Kieta Volc
Oligocene		Kieta Volcanics (Tk) Oligocene? -e Miocene	1500+	CENTRAL BOUGAINVILLE I S: Agglomerate, tuff; sandstone, siltstone, conglomerate composed of volcanic material; cross-bedded; andesitic and basaltic lava erupted subaerially; pillow lava	Coarser dep probably laid down in alluv fans adjacent to high volc mtns. Unconf below Keriaka Lst and Bougainville Gp. Dated by foram
		Jaulu Volcanics (Toj) m-l Oligocene	2000+	NEW IRELAND: Mainly coarse andesitic lapilli tuff and agglomerate; clasts subangular with chilled or altered margins; less common welded ash-flow tuff, amygdaloidal and pillow lava, and tuffaceous limestone; local small lenses of coralline limestone	Form 'basement' of much of New Ireland; possibly built up from sea floor and some erupted in subaqueous envir. Unconf below e Mio and younger biogenic Lelet and Surker Lst and some clastic sed rocks (Lossuk R Beds). Dated by foram (e Te); K-Ar dating of 30.1 ± 1.0 m.y. from one sample (Hohnen, in prep.)

ADMIRALTY ISLANDS (9)

Age	IM map unit	Constituent unit(s) in 1:250 000 Sheet areas	Thickness (m)	Lithology	Additional pertinent data
Quaternary	Qa^9	Qa Pleistocene-Holocene	50	ADMIRALTY I E, W: Alluvium and beach deposits: gravel, sand, silt, mud, clay	Coastal Manus and Rambutyo Is
		Qs Pleistocene-Holocene (Included in Qv^9)	10	ADMIRALTY I W: Colluvium: chaotic deposits of angular rock fragments	Slumps on scarp surrounding South West Bay, Manus
		Qc Pleistocene-Holocene	20	ADMIRALTY I E, W: Raised coral reefs: biocalcirudite, algal-coralline biomicrite, biocalcarenite	Smaller islands; fringing and platform reef complexes. Corals, algae, bry, biv, gast. Dated by plank and larger foram. Unconf on Lorengau Bs, Naringel Lst, Lauis Fm
		Kulep Limestone (Qpk) Pleistocene		ADMIRALTY I E: Coralgal biomicrite and biocalcirudite; biocalcarenite	Raised platform reefs on Rambutyo and Nauna Is. Unconf on Tmr, unconf below Qr, Qa. Dated by forams as Mio-Holo; considered to be Pleist on basis of stratigraphy. Also contains mollusc and algal frag, and bry. Phosphate on Nauna formed on old lagoonal surface
		Coral sand Pleistocene-Holocene	to 4	WUVULU, NINIGO: Coral sand, soil, boulders	Phosphate-crust and guano on Wuvulu and Aua Is (White & Warin, 1964)
		Naringel Limestone (Qpn) Pliocene-Pleistocene (At least in part included in Qv^9)	100	ADMIRALTY I E: Biocalcirudite, algal-foraminiferal biomicrite, biocalcarenite	Fringing and platform reef complex. Unconf on Lorengau Bs and Lauis Fm. Contains corals, algae, bry, biv, gast, larger foram. Source of road agg; potential source of lime

Qv^9	Baluan Basalt (Qb) Pleistocene-Holocene		ADMIRALTY I E: Porphyritic basalt lava and pyroclastics, partly reworked	Baluan and Mok Is. No recorded history of eruption, but Baluan I has thermal emission points. Bs are mildly alkaline and transitional (Johnson & Smith, 1974)
	Tuluman Volcanics (Qt) Pleistocene-Holocene		ADMIRALTY I E: Obsidian, pitchstone, and rhyolite lava; pumiceous pyroclastics; partly reworked	Lou, Tuluman, and Pam Is, which may lie on nascent ring fracture. 12 eruptive centres identified on Lou I. Tuluman erupted in 1953-7 as submarine and subaerial explosive and effusive events (Reynolds & Best, 1957; Reynolds, 1958). Each of Pam Is is a single lava extrusion. Rocks have highly siliceous, near-peralkaline comp (Johnson & Smith, 1974)
	Fedarb Volcanics (Qfd, Qfb) Pleistocene-Holocene		ADMIRALTY I E: Dacite (Qfd) and basalt (Qfb) lava and pyroclastics, lahars, reworked pyroclastics	Bs on Fedarb Is except Sivisa I; dacite only on Sivisa I. No recorded history of eruption; may be remnants of collapsed eroded volcano. Bs of qtz tholeiite comp (Johnson & Smith, 1974)
Quaternary	Qv Pleistocene-Holocene		ADMIRALTY I E,W: Lava, pyroclastics, reworked pyroclastics	Johnstone and Mbuke Is, S of Manus. No recorded history of eruption.
	Likum Basalt (Qpl) Pleistocene	200	W ADMIRALTY I W: Basaltic lava, commonly vesicular, including olivine basalt; thin acidic tuff and lapilli tuff near base	Shallow-water marine explosive volc activity followed by slow, mainly subaerial, effusive activity. Unconf on Tasikim Aglm, Lauis Fm. Dated by K-Ar method as 1.73 ± 0.3 m.y. Prospective for bx as area covered by red clays
	Tasikim Agglomerate (Tpt) Pliocene	400	W ADMIRALTY I W: Coarse andesitic agglomerate, lapilli tuff; tuff partly reworked; minor lava, flow-banded in places	Explosive volc activity in and around shallow marine envir and coastal area of low relief. Unconf on Tinniwi Volc, Mundrau Lst, Lauis Fm; unconf below Likum Bs. Possibly thickest in SW

Units not differentiated, at least in part, from Qv^9 on 1:1 000 000 map: Pleist-Holo Qs and Plio-Pleist Naringel Lst (see Qa^9); and m Mio-Plio Lorengau Bs, m? or l Mio-Plio Lauis Fm, m? or l Mio Plio Rambutyo Beds, and Plio Tpi (see Tmu^9)

Tmu^9	Rambutyo Beds (Tmr) m? or l Miocene-Pliocene (At least in part included in Qv^9)	1000	ADMIRALTY I E: Tuffaceous calcareous lithic arenite, siltstone, mudstone; well bedded; interbedded paraconglomerate in places	Lithologically similar to Lauis Fm. Unconf below Qc. Dated by plank foram as N17-19 in part
	Lorengau Basalt (Tmb) m Miocene-Pliocene (At least in part included in Qv^9)	200	ADMIRALTY I E: Andesitic lava, commonly feldsparphyric; basalt, olivine basalt	Widespread subaerial flows in W, and submarine followed by subaerial flows in E. Unconf on Tinniwi Volc, Mundrau Lst, and in part on Lauis Fm, with which partly interf; unconf below Naringel Lst. Older portions exposed in S. Two main periods of volc indicated: m Mio and l Mio-Plio. Dated at 13.5 ± 0.8 m.y. and 7.9 ± 0.5 and 8.6 ± 0.6 m.y. by K-Ar method. Bx in places
Late Miocene	Lauis Formation and Tingau Conglomerate (Tml, Tmg) m? or l Miocene-Pliocene (At least in part included in Qv^9, Tmm^9)	3000	ADMIRALTY I E, W: Tuffaceous calcareous lithic arenite, siltstone, mudstone; well bedded with some conglomerate, rare limestone; lignitic in places; interbedded basalt flows in places; also cut by basaltic dykes. Coarse conglomerate, pebble conglomerate, minor coarse lithic arenite	Partly paralic, but mainly deeper-water clastics. Capped by Lorengau Bs in places. Contains molluscs, bry, coral frag. Dated by plank foram as N16-19 in part. Facies equiv of Tingau Cgl
	Tpi Pliocene (At least in part included in Qv^9)		ADMIRALTY 1 E: Porphyritic microdiorite and feldspar porphyry	Small po accompanied by alteration and py mineraliz. Intrudes Rambutyo Beds; equiv? of Yirri Intr Comp

Unit not differentiated, at least in part, from Tmu^9 on 1:1 000 000 map: 1 Eo-e Mio Tinniwi Volc (see To^9)

Middle Miocene	Tmm^9	Yirri Intrusive Complex (Tmy) m Miocene (At least in part included in To [illegible]	ADMIRALTY I E, W: Medium-grained quartz diorite, quartz monzodiorite, quartz monzonite, tonalite. Dacite porphyry at margins of complex	Generally unaltered, mainly medium-grained composite intr; possibly multiphase. Dates range from 10.1 ± 0.8 m.y. to 17.6 ± 0.7 m.y. possibly indicating a number of pulses. Intruded by po phases with concomitant alteration; intrudes Tinniwi Volc
		Dremsel alunitic phase (of Yirri Intrusive Complex) (Tmyd) m Miocene (At least in part included in To^9, Tou) 300 max	ADMIRALTY I E, W: Quartz alunite, zeolite, pyrite-bearing breccia; altered and brecciated intermediate pyroclastics and breccia	Overlies Yirri Intr Comp; directly overlies po phases; presence of Tmyd clasts in Tasikim Aglm indicates up age limit of 1 Mio. Widespread brec, silicif, pyritiz, and advanced argillic alteration thought to be caused by late-stage resurgent boiling of intr. May represent altered coeval ad volc and subvolc pile, or may be altered basement Tinniwi Volc. Some Cu mineraliz; possibility of secondary enrichment near base
		Mundrau Limestone (Tmm) e-m Miocene (At least in part included in To^9) 200	ADMIRALTY I E, W: Massive to poorly bedded algal-foraminiferal biomicrite, well bedded calcarenite at base	Probably dev as fringing reefs about volc islands. Unconf on Tinniwi Volc; unconf below Tasikim Aglm and Lauis Fm. Probably suitable for lime production. Dated by larger foram as 1 Te-e Tf. Contains molluscs, echino and serpulid frag
		Units not differentiated, at least in part, from Tmm^9 on 1:1 000 000 map: 1 Eo-e Mio Tinniwi Volc (see To^9); and m? or 1 Mio-Plio Lauis Fm (see Tmu^9)		
Late Oligocene	Tou	Unit not differentiated, at least in part, from Tou on 1:1 000 000 map: m Mio Dremsel alunitic phase (see Tmm^9)		

Oligocene	To^9	Tinniwi Volcanics (Tot) 1 Eocene-e Miocene (At least partly included in Tmu^9, Tmm^9)	ADMIRALTY I E, W: Andesitic and basaltic agglomerate, tuff, lava, lava breccia; lithic greywacke, some limestone lenses near top	Oldest rocks exposed on Manus I. Unconf below Mundrau Lst. Dated by K-Ar method as 44.6 ± 5.0, 47.8 ± 5.0, 20.2 ± 0.8 m.y.

Units not differentiated, at least in part, from To^9: m Mio Dremsel alunitic phase and Yirri Intr Comp and e-m Mio Mundrau Lst (see Tmm^9)

CITED REFERENCES

BAIN, J.H.C., & MACKENZIE, D.E., 1974 - Karimui, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner Resour. Aust. explan Notes SB/55-9.

BAIN, J.H.C., & MACKENZIE, D.E., 1975 - Ramu, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan Notes SB/55-5.

BAIN, J.H.C., MACKENZIE, D.E., & RYBURN, R.J., 1975 - Geology of the Kubor Anticline, Central Highlands of Papua New Guinea. Bur. Miner. Resour. Aust. Bull. 155.

BLAKE, D.H., 1967 - Bougainville Island North and South - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SB/56-8, and 12.

BLAKE, D.H., & MIEZITIS, Y., 1967 - Geology of Bougainville and Buka Islands, New Guinea. Bur. Miner. Resour. Aust. Bull. 93.

BROWN, C.M., 1974 - Explanatory notes on the Yule geological sheet. Geol. Surv. Papua New Guinea Rep. 74/27 (unpubl.). In prep. as: Yule, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SC/55-2.

BROWN, C.M., in prep. - Explanatory notes on the Kavieng geological map. Geol. Surv. Papua New Guinea Rep. (unpubl.). Also in prep. as: Kavieng, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan Notes SA/56-9.

BROWN, C.M., & ROBINSON, G.P., in prep. - Expanatory notes on the Lake Kutubu geological map. Geol. Surv. Papua New Guinea Rep. (unpubl.). Also in prep. as: Lake Kutubu, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan Notes SB/54-12.

DAVIES, H.L., 1973a - Fergusson Island, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SC/56-5.

DAVIES, H.L., 1973b - Gazelle Peninsula, New Britain - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SB/56-2.

DAVIES, H.L., in prep. - Buna, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SC/55-3.

DAVIES, H.L., & HUTCHISON, D.S., in prep. a - Wabag, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SB/54-8.

DAVIES, H.L., & HUTCHISON, D.S., in prep. b - May River, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SB/54-3.

DAVIES, H.L., & HUTCHISON, D.S., in prep. c - Ambunti, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SB/54-4.

DAVIES, H.L., & NORVICK, M., 1974 - Blucher Range, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SB/54-7.

DAVIES, H.L., & SMITH, I.E., 1974 - Tufi-Cape Nelson, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SC/55-8 and 4.

DOW, D.B., SMIT, J.A.J., BAIN, J.H.C., & RYBURN, R.J., 1972 - Geology of the south Sepik region, New Guinea. Bur. Miner. Resour. Aust. Bull. 133.

DOW, D.B., SMIT, J.A.J., & PAGE, R.W., 1974 - Wau, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SB/55-14.

GRAINGER, D.J., & TINGEY, R.J., 1976 - Markham, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SB/55-10.

HOHNEN, P.D., in prep. - Geology of New Ireland, Papua New Guinea. Bur. Miner. Resour. Aust. Bull. 194.

HUTCHISON, D.S., in prep. - Sepik, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SA/55-13.

HUTCHISON, D.S., & NORVICK, M.A. in prep. - Wewak, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SA/54-16.

JAQUES, A.L., 1976 - Explanatory notes on the Admiralty Islands geological map. Geol. Surv. Papua New Guinea Rep. 76/15 (unpubl.). In prep as: Admiralty Islands, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SA/55-10 and 11.

JAQUES, A.L., & ROBINSON, G.P., 1975 - Explanatory notes on the Bogia geological sheet. Geol. Surv. Papua New Guinea Rep. 75/12 (unpubl.). In prep. as: Bogia, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SB/55-1.

JOHNSON, R.W., & SMITH, I.E., 1974 - Volcanoes and rocks of St Andrew Strait, Papua New Guinea. J. geol. Soc. Aust., 21, 333-52.

JOHNSON, R.W., TAYLOR, G.A.M., & DAVIES, R.A., 1972 - Geology and petrology of Quaternary volcanic islands off the north coast of New Guinea. Bur. Miner. Resour. Aust. Rec. 1972/21 (unpubl.).

KEYSER, F. de, 1961 - Misima Island, geology and gold mineralization. Bur. Miner. Resour. Aust. Rep. 57.

NORVICK, M.A., & HUTCHISON, D.S., in prep. - Vanimo-Aitape, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SA/54-11 and 15.

PIETERS, P.E., 1974 - Explanatory notes on the Port Moresby, Kalo and Aroa geological map. Geol. Surv. Papua New Guinea Rep. 74/28 (unpubl.). In prep as: Port Moresby-Kalo-Aroa, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SC/55-7, 11, and 6.

PIETERS, P.E., in prep. - Explanatory notes on the Kikori geological sheet. Geol. Surv. Papua New Guinea Rep. (unpubl.). Also in prep. as: Kikori, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SB/55-13.

REYNOLDS, M.A., 1958 - Activity of Tuluman volcano, St Andrew Strait, Admiralty Islands, September 1955-March 1957. Bur. Miner. Resour. Aust. Rec. 1958/14 (unpubl.).

REYNOLDS, M.A., & BEST, J.G., 1957 - The Tuluman volcano, St Andrew Strait, Admiralty Islands. Bur. Miner. Resour. Aust. Rep. 33.

ROBINSON, G.P., 1974 - Huon-Sag Sag, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SB/55-11 and 7.

ROBINSON, G.P., & JAQUES, A.L., 1974 - Explanatory notes on the Karkar Island geological sheet. Geol. Surv. Papua New Guinea Rep. 74/18 (unpubl.). In prep. as: Karkar Island, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SB/55-2.

ROBINSON, G.P., JAQUES, A.L., & BROWN, C.M., 1976 - Madang, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SB/55-6

RYBURN, R.J., 1974a - Pomio, New Britain - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SB/56-6.

RYBURN, R.J., 1974b - Talasea-Gasmata, New Britain - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SB/56-5 and 9.

RYBURN, R.J., 1976 - Cape Raoult-Arawe, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. NotesSB/55-8 and 12.

SMITH, I.E., 1972 - High-potassium intrusives from southeastern Papua. Contr. Miner. Petrol., 34, 167-76.

SMITH, I.E., 1973 - Late Cainozoic volcanism in the southeast Papuan islands. Bur. Miner. Resour. Aust. Rec. 1973/67 (unpubl.).

SMITH, I.E., & DAVIES, H.L., 1973a - Abau, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SC/55-12

SMITH, I.E., & DAVIES, H.L., 1973b - Samarai, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SC/56-9.

SMITH, I.E., & PIETERS, P.E., 1969 - The geology of the Louisiade Archipelago, T.P.N.G., excluding Misima Island. Bur. Miner. Resour. Aust. Rec. 1969/93 (unpubl.).

TRAIL, D.S., 1967 - Geology of Woodlark Island. Bur. Miner. Resour. Aust. Rep. 115.

WALLACE, D., in prep. - Explanatory notes on the Mussau Island geological map. Geol. Surv. Papua New Guinea Rep. (unpubl.). Also in prep. as: Mussau Island, Papua New Guinea - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan.Notes SA/55-8.

WHITE, W.C., & WARIN, O.N., 1964 - A survey of phosphate deposits in the south-west Pacific and Australian waters. Bur. Miner Resour. Aust. Bull. 69.

WILLMOTT, W.F., 1972 - Daru-Maer, Papua and Queensland - 1:250 000 Geological Series. Bur. Miner. Resour. Aust. explan. Notes SC/54-8 and 5.

APPENDIX 1

ABBREVIATIONS USED IN 'ADDITIONAL PERMANENT DATA' COLUMN

Abundant	abd	Composition(al)	comp
Agglomerat/-e, -ic	aglm	Conform/-able, -ably	conf
Aggregate	agg	Conglomerate	cgl
Alluv/-ium, -ial	alluv	Construction	constr
Ammonite(s)	amm	Contemporaneous	contemp
Andesit/-e, -ic	ad	Copper	Cu
Argillite	arg	Correlat/-e(d), -ive	corr
Arkose	ark	Cretaceous	Cret
Asbestos	as	Deposit(ed)	dep
Assemblage	assem	Develop/-ed, -ment	dev
Associat/-ed, -ion	assoc	Differentiated	diff
Azurite	az	Diorit/-e, -ic	dr
Basalt(ic)	bs	Disconform/-able, -ably, -ity	disconf
Bauxite	bx	Disseminat/-ed, -ions	dissem
Belemnite(s)	blm	Dolerit/-e, -ic	dl
Benthonic	benth	Early	E, e
Biomicrite	biomic	East	E
Biotit/-e, -ic	biot	Echinoderm(s)	echino
Bivalve(s)	biv	Environment	envir
Brachiopod(s)	brach	Eocene	Eo
Breccia(ted)	brec	Epidote	ep
Bryozoan(s)	bry	Equivalen/-t, -ce	equiv
Calcarenite	calcaren	Fanglomerate	fgl
Calc/-ite, -areous	calc	Fluviatile	fluv
Calcilutite	calcilut	Foraminiferida	foram
Campanian	Camp	Formation	Fm, fm
Carbon/-aceous, -ized	carb	Fossil(iferous)	foss
Cenomanian	Cen	Fragment(s)/-ary	frag
Chalcocite	cc	Gabbro	gb
Chalcopyrite	ch	Gastropods	gast
Chlorit/-e,-ic	chl	Glauconit/-e, -ic	gl
Chromite	cr	Gneiss	gn
Claystone	clst	Gold	Au
Complex (named)	Comp	Gradational	grad

APPENDIX 1 (continued)

Granite	gr	Monazite	mz
Granodiorit/-e, -ic	gd	Mount	Mt
Graphit/-e, -ic	gt	Mountain(s)	Mtn(s)
Gravel	gv	Mudstone	mdst
Greywacke	gwke	Nickel	Ni
Group	gp	North	N
Hematite	hem	Oligocene	Oligo
Hornblende	hbl	Paleocene	Paleo
Indeterminate	indet	Paraconformable	paraconf
Intercalat/-ed, -ion(s)	intcal	Peninsula (named)	Pen
Interfinger	interf	Petroleum	petrol
Intrus/-ion, -ive	intr	Phosphat/-e, -ic	ph
Iron	Fe	Plagioclase	plag
Island(s)	I(s)	Planktonic	plank
Jurassic	Jur	Platinum	Pt
Late	L, l	Pleistocene	Pleist
Lateral(ly)	later	Pliocene	Plio
Limestone	lst	Porphyr/-y, -itic	po
Limonit/-e, -ic	lim	Pyrit/-e, -ic	py
Lower	low	Pyritization	pyritiz
Maastrichtian	Maast	Pyrrhotite	pyrrh
Magnesite	ms	Quartz	qtz
Magnetite	mt	Quaternary	Quat
Malachite	ml	Range(s) (named)	Ra(s)
Manganese	Mn	Relation	relat
Member	Mem, mem	River (named)	R
Mesozoic	Mes	Rutile	rut
Metabasalt	metabs	Sandstone	sst
Metadiorite	metadr	Sediment(ary)	sed
Metamorph/-ic(s),-ism,-osed	metam	Senonian	Sen
Microdiorite	microdr	Serpentin/-e, -ite	serp
Microplankton	micropl	Shale	sh
Middle	M, m	Silicification	silicif
Mineralization	mineraliz	Siltstone	sltst
Miocene	Mio	Silver	Ag
Molybdenum	Mo	South	S

APPENDIX 1 (continued)

Strat/-a, -igraphic	strat
Structure	struc
Sulphur	S
Superposition	superpos
Terrestrial	(
Terrigenous	terr
Tertiary	Tert
Thorium	Th
Transition(al)	trans
Turbidity currents	t.c.
Turonian	Tur
Ultramafic(s)	ultram
Unconform/-ity,-able,-ably	unconf
Undifferentiated	undiff
Unfossiliferous	unfoss
Upper	up
Volcan/-ic(s),-ically,-ism	volc
West	W
Zinc	Zn

APPENDIX 2

ALPHABETICAL LIST OF 1:250 000 SHEETS AND MAIN REFERENCES

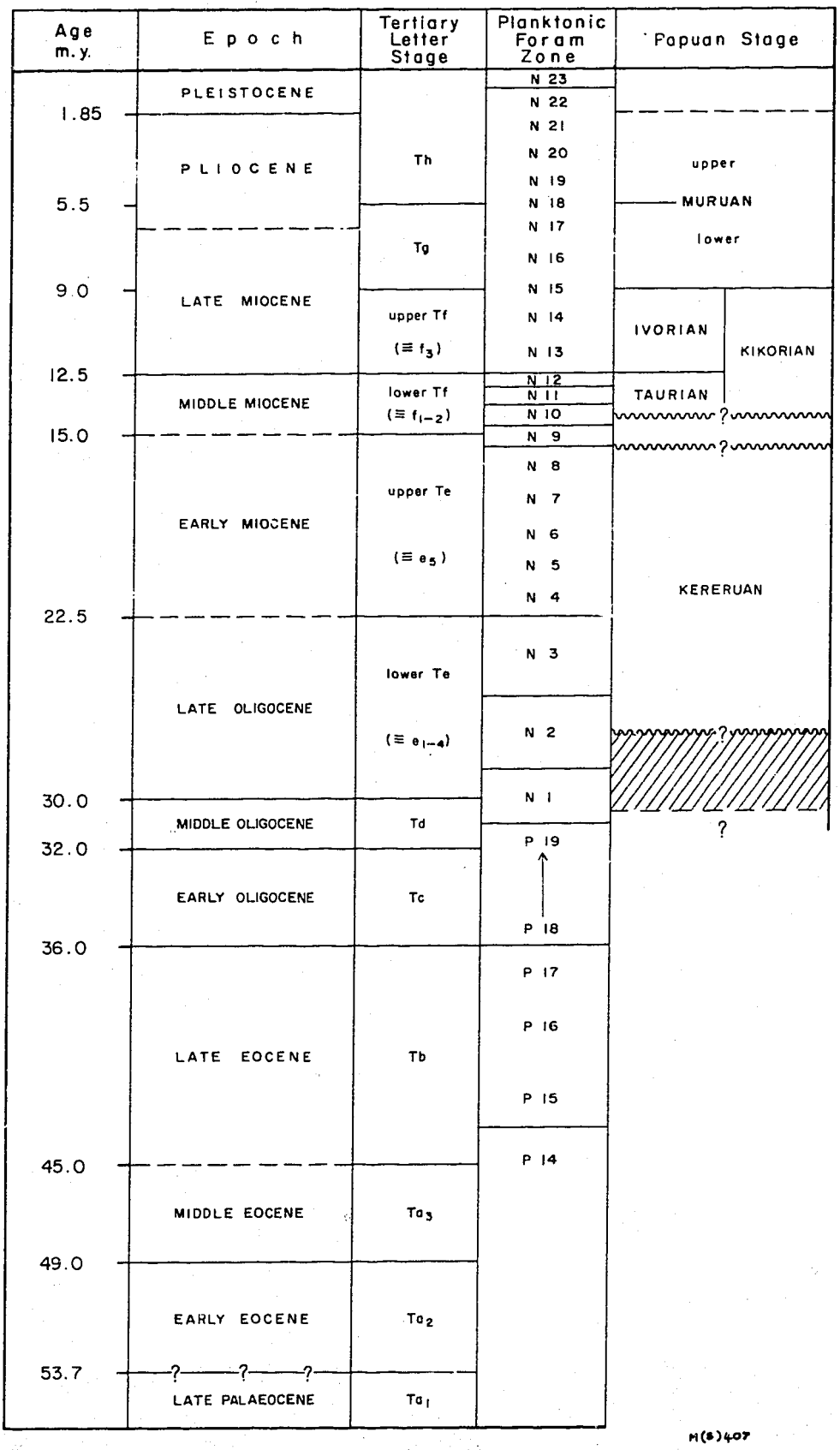
Abau (SC55-12): Smith & Davies (1973a)
Admiralty Is E and W (S55-10,11): Jaques (1976)
Aitape (SA54-15): (see Vanimo-Aitape)
Ambunti (SB54-4): Davies & Hutchison (in prep.c); Dow, Smit, Bain, & Ryburn (1972)
Arawe (SB55-12): (see Cape Raoult-Arawe)
Aroa (SC55-6): (see Port Moresby, Kalo, and Aroa)
Aworra River (SB54-16): Not mapped
Blucher Range (SB54-7): Davies & Norvick (1974)
Boigu(SC54-7): Not mapped
Bogia (SB55-1): Jaques & Robinson (1975); Johnson, Taylor, & Davies (1972)
Bougainville I N and S (SB56-8,12): Blake (1967); Blake & Miezitis (1967)
Buna (SC55-3): Davies (in prep.)
Calvados (SC56-14): Not mapped
Cape Nelson (SC55-4): (see Tufi-Cape Nelson)
Cape Raoult-Arawe (SB55-8, 12): Ryburn (1976)
Cape St George (SB56-3): (see New Ireland and Tabar Islands)
Daru-Maer (SC54-8, 55-5): Willmott (1972)
Deboyne (SC56-10): Mapped in part by de Keyser (1961)
Fergusson I (SC56-5): Davies (1973a)
Fly River (SC54-3): Not mapped
Gasmata (SB56-9): (see Talasea-Gasmata)
Gazelle Peninsula (SB56-2): Davies (1973b)
Gulf (SC55-1): Not mapped
Huon-Sag Sag (SB55-11,7): Robinson (1974)
Kalo (SC55-11): (see Port Moresby, Kalo, and Aroa)
Karimui (SB55-9): Bain & Mackenzie (1974); Bain, MacKenzie, & Ryburn (1975)
Karkar I (SB55-2): Robinson & Jaques (1974); Johnson, Taylor,& Davies (1972)
Kavieng (SA56-9): (see New Ireland and Tabar Islands); Brown (in prep.)
Kikori (SB55-13): Pieters (in prep.)
Kilinailau (SB56-4): Not mapped
Kiwai (SC54-4): Not mapped
Lake Kutubu (SB54-12): Brown & Robinson (in prep.)
Lake Murray (SB54-15): Not mapped
Mabua (SA56-10): Mapped, but state of progress not known

APPENDIX 2 (continued)

Madang (SB55-6): Robinson, Jaques, & Brown (1976); Johnson, Taylor, & Davies (1972)
Maer (SC55-5): (see Daru-Maer)
Markham (SB55-10): Grainger & Tingey (1976)
May River (SB54-3): Davies & Hutchison (in prep.b); Dow, Smit, Bain, & Ryburn (1972)
Mussau I (SA55-8): Wallace (in prep.)
Namatanai (SA56-14): (see New Ireland and Tabar Islands)
New Ireland and Tabar Islands: Hohnen (in prep.)
Ninigo (SA55-5): Not mapped (but see White & Warin, 1964)
Nuguria (SA56-16): Not mapped
Nukumanu (SB57-1): Not mapped
Pomio (SB56-6): Ryburn (1974)
Port Moresby, Kalo, and Aroa (SC55-7, 11, 6): Pieters (1974, in prep.)
Ramu (SB55-5): Bain & Mackenzie (1975); Bain, Mackenzie, & Ryburn (1975)
Raggi (SB54-11): Mapped but state of progress not known
Rossel (SC56-5): Smith & Pieters (1969)
Sable (SC56-13): Not mapped
Sag Sag (SB55-7): Partly mapped (see Huon-Sag Sag; also Johnson, Taylor, & Davies, 1972)
Salamaua (SB55-15): Mapped but state of progress not known
Samarai (SC56-9): Smith & Davies (1973b)
Samo (SA56-15): (see New Ireland and Tabar Islands)
Sepik (SA55-13): Hutchison (in prep.); Johnson, Taylor, & Davies, 1972
Talasea-Gasmata (SB56-5, 9): Ryburn (1974)
Tauu (SB57-1): Not mapped
Tench (SA56-5): Not mapped
Tingwon (SA55-12): Not mapped
Trobriand Islands (SC56-1): Not mapped
Tufi-Cape Nelson (SC55-8, 12): Davies & Smith (1974)
Vanimo-Aitape (SA54-11,15): Norvick & Hutchison (in prep.)
Wabag (SB54-8): Davies & Hutchison (in prep.a); Dow, Smit, Bain, & Ryburn (1972)
Wau (SB55-14): Dow, Smit, & Page (1974)
Wewak (SA54-16): Hutchison & Norvick (in prep.)
Witu Is (SB55-4): Not mapped (but see Johnson, Taylor, & Davies, 1972)
Woodlark (SC56-6): Trail (1967)
Wuvulu I (SA54-8): Not mapped (but see White & Warin, 1964)
Yule (SC55-2): Brown (1974, in prep.)

Appendix 3

STANDARD CAINOZOIC TIME SCALE FOR PAPUA NEW GUINEA



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INDEX 1

ALPHABETICAL LISTS OF STRATIGRAPHIC UNITS AND UNNAMED MAP SYMBOLS

Listed below, in alphabetical order, are all the stratigraphic names and symbols which are discussed in the compiled tables. The names have unequal status, and a special effort has been made to ensure that the status of each is clearly stated.

Firstly, there are the formal names, marked by an asterisk (*), which have been officially defined in geological literature. Then there are those which, although used in published literature for some time, have never been formally defined; these are marked by a cross (+). Names reserved but not as yet officially defined in published literature are denoted by a minus (-) sign. Names marked with a diagonal stroke (/) are those which though never formally defined have been used in literature, though in a different form, e.g. as series rather than beds.

(a) Stratigraphic Units

(b) Unnamed Map Symbols

List of other informal terms

INDEX 2

LISTS OF STRATIGRAPHIC AND DESCRIPTIVE NAMES AND UNNAMMED MAP SYMBOLS IN CHRONOLOGICAL ORDER

(a) Stratigraphic and descriptive names

PLEISTOCENE, HOLOCENE

(e Mio?-Pleist):102; Star Mountains Intrusives (1 Mio-Pleist):29; Suaru Volcanics (Quat):27,38; Sugarloaf Volcanics (Quat):28; Takuan Volcanics (Plio, Pleist, Holo):101; Taroka Volcanics (Plio, Pleist, Holo):101; Timbe River Conglomerate (Pleist):85; Tore Volcanics (Plio-Pleist-Holo):101; Tuluman Volcanics (Pleist-Holo):106; Ubo Fanglomerate (Holo):50; Ulahau Fanglomerate (Plio?-Pleist?):8; Uluputur Beds (1? Pleist):102; Uoivi Volcanics (Pleist-Holo):52; Victory Volcanics (Pleist-Holo):52; Waiowa Volcanics (Holo):51; Wakioki Fanglomerate (Holo):50; Wandokai Limestone (Quat):84; Wirui Limestone (Pleist-Holo):6; Wongop Sandstone (Plio or younger):30; Wosera Beds (Pleist?):7; Wuro Beds (Plio?-Pleist?):8

PLIOCENE

Amphlett Volcanics (Plio):77; Antares Monzonite (1 Mio-Pleist):29; Apinaipi Formation (Plio):54,57; Aria Beds (Plio):95; Astrolabe Agglomerate (Plio):58; Awaitapu Claystone (Plio?):55; Babwaf Conglomerate (Plio?):55; Bagana Volcanics (Plio, Pleist, Holo):101; Bakanovi Volcanics (Plio, Pleist, Holo): 101; Balbi Volcanics (Plio, Pleist, Holo):101; Barida Beds (1 Mio-e Plio): 16; Bewani Formation (Plio):10; Border Mountains Limestone Beds (Mio?, Plio?):15; Bougainville Group (Plio, Pleist, Holo):101; Bulimp Formation (1 Plio?-Pleist?): 9; Bulolo Agglomerate (Plio):56; Cloudy Bay Volcanics (Plio):55; Crater Mountain Volcanics (Plio-Holo):39; Diorite (Oligo?-Pleist?):102; Domara River Conglomerate (Plio):54; Edie Porphyry (Plio):53; Emperor Range Volcanic Beds (Plio, Pleist, Holo):101; Era Beds (Plio, Pleist): 30; Esis Beds (1 Mio-Plio): 97; Fife Bay Volcanics (Plio):55; Fubilan stock (1 Mio-Pleist): 29; Fuk Beds (Plio):14; Gidogidora Granodiorite (Plio):76; Gowop Limestone (e or m Mio-Plio):88; Gwenif Formation (Plio):15; Gwoira Conglomerate (Plio):55; Intrusives (Plio):29; Ipe Formation (Plio):12; Johanna Beds (Plio and younger):95; Kabenau Beds (Mio-Pleist):87; Kabwum Limestone Member (e or m Mio-Plio):88; Kapiura Beds (Plio):96; Krisi Formation (1 Plio?):10; Kukuia Volcanics (Plio, Pleist):77; Kumal Marl Member (Plio):13; Kupiano Beds (1 Mio, e Plio):59; Kwikila Agglomerate (Plio):58; Kwinimaga Sandstone (Plio?):54; Lakit Limestone(Plio):95; Lauis Formation (m? or 1 Mio-Plio):107;Lelet Limestone (1 e Mio-Plio-Pleist?):103; Leron Formation (m Mio, 1 Plio, Pleist?): 56,86; Liddle Conglomerate (Plio):30; Lorengau Basalt (m Mio-Plio):107; Luboda Granodiorite (Plio):76; Lumi Formation (Plio):15; Mai Conglomerate Member (e Plio):13; Mai'iu Monzonite (1 Mio-e Plio):63; Mailu Sandstone (Plio):55; Maprik Mudstone (Plio-Pleist):12; Marabu Limestone (e Plio?):15; Miaru Mudstone (1 Mio-e Plio):60; Misa Formation (e Plio):13; Molang Creek

Formation (e Plio):14; Mount Davidson Volcanics (Plio):58; Mount Ian gabbro (l Mio-Pleist):29; Mount Suau Member (Plio):55; Mungu Volcanics (Plio):96; Musa Volcanic Member (Plio):54; Mwatebu Sandstone (Plio):76; Namie Breccia (Plio):56; Nanu Formation (Plio):12; Naringel Limestone (Plio, Pleist):105; Nengare Member (Plio):11; Neni Formation (Plio):11; Nopan Sandstone (Plio-Pleist):8; Normanby Volcanics (Plio):77; Numa Numa Volcanics (Plio, Pleist, Holo):101; Observation Island Granodiorite (Plio):76; Omara Granodiorite (Plio):76; Orubadi Formation (l Mio-Plio):30; Otibanda Formation (Plio):56; Ouba Beds (Plio):86; Pana rora Volcanics (Plio, Pleist?):76; Penk Volcanic Complex (Plio?):96; Punam Limestone (Plio or younger):102; Rambutyo Beds (m? or l Mio-Plio):107;Rataman Formation (l Mio-e Plio):103; Reini Volcanics (Plio, Pleist, Holo):101; Rofula Member (Plio):11; Romi Formation (l Plio?): 9; Ruaba Sandstone (m Mio-Plio):60; Sai Beds (l Mio, Plio, or younger):95; Sargum Conglomerate (e Plio):14; Serra Hills Limestone (l Plio-Pleist):9; Sesara Volcanics (l Mio-e Plio):57; Sibi Sandstone Member (Plio-Pleist?):9; Sigule Volcanics (l Mio-Plio):96; Sinewit Formation (l Mio-Plio):96; Siro Conglomerate (l Mio-e Plio):59; Sohano Limestone (e Mio?-Pleist):102; Song River Calcarenite (Mio-Plio):88; Songaien Formation (e Plio):13; Star Mountains Intrusives (l Mio-Pleist):29; Takuan Volcanics (Plio, Pleist, Holo):101; Taroka Volcanics (Plio, Pleist, Holo):101; Tasikim Agglomerate (Plio):106; Tingau Conglomerate (m? or l Mio-Plio):107; Toki Andesite (Plio): 96; Tore Volcanics (Plio, Pleist, Holo):101; Tumoflu Mudstone Member (Plio): 11; Uga Sandstone (Plio):55; Ulahau Fanglomerate (Plio?-Pleist?):8; Uvo Volcanics (l Plio):87; Wedge Hill Limestone (Plio):57; Wewak Beds (Plio):10; Wongop Sandstone (Plio or younger):30; Wuro Beds (Plio?-Pleist?):8; Yaifa Formation (l Mio-e Plio):58

MIOCENE

Adau Limestone (e-m Mio):62; Aifunka Volcanics (m Mio): 42; Akuna Intrusive Complex (e Mio):41; Amogu Conglomerate (e-m Mio):18; Antares Monzonite (l Mio-Pleist):29; April Ultramafics (m Mio):19; Aure Beds (m Oligo-l Mio):33,64; Barida Beds (l Mio-e Plio):16; Benembi Diorite (l Mio):39; Bismarck Intrusive Complex (m Mio):40; Bliri Volcanics (L Cret?, Paleo?-Mio):22; Boera Limestone (l Oligo-e Mio):65; Bootless Inlet Limestone (l Oligo-e Mio):66; Border Mountains Limestone Beds (Mio?, Plio?):15; Buka Formation (Oligo?-e Mio?):104; Burgess Formation (l Mio):17; Castle Hill Limestone (m Mio):62;

(l Mio):63; Suloga Limestone (e Mio):79; Surker Limestone (e Mio):103; Tabukui Beds (e Mio):79; Talama Volcanics (m-l Mio):59; Tapio Marl (l Mio): 60; Tarua Volcanic Member (m-l Mio):17; Tibinini Limestone Member (l Oligo?-m Mio):32; Tingau Conglomerate (m? or l Mio-Plio):107; Tinniwi Volcanics (l Eo-e Mio):109; Tipsit Limestone (l Oligo-m Mio):89; Torricelli Intrusive Complex (L Cret-e Mio):20; Ulo Ulo Gabbro (l Oligo?-m Mio):63; Wai Asi Beds (m?-l Mio):31; Warre Limestone Member (m Mio):31; Watuti Gabbro (l Oligo?-m Mio):63; Wogamush Beds (m-l Mio):17; Wonai Hill Formation (e Mio):78; Woruka Siltstone (e Mio):64; Yaifa Formation (l Mio-e Plio):58; Yalam Limestone (Mio): 97; Yangi Beds (l Oligo?-m Mio):32; Yaveufa Formation (m Mio):41; Yirri Intrusive Complex (m Mio):108.

OLIGOCENE

Aure Beds (m Oligo-l Mio):33,64; Bliri Volcanics (L Cret?, Paleo?-e Mio):22; Boera Limestone (l Oligo-e Mio):65; Bootless Inlet Limestone (l Oligo-eMio): 66; Buka Formation (Oligo?-e Mio?):104; Chimbu Limestone (m Eo-e Oligo):43; Dabi Volcanics (l Oligo):66; Darai Limestone (l Eo-m Mio):32; Debolina Beds (l Oligo-Mio):65; Diorite (Oligo?-Pleist?):102; Dokuna Tuff (l Oligo-e Mio): 66; Finisterre Volcanics (e Oligo-e Mio):91; Gabahusuhusu Syenite (l Oligo?-m Mio):63; Imudat Monzonite (l Oligo?-m Mio):63; Intrusives (l Eo-Mio):98; Intrusives (l Oligo):98; Jaulu Volcanics (m-l Oligo):104; Kapuluk Volcanics (l Oligo):98; Kieta Volcanics (Oligo?-e Mio?):104; Kwama Basalt (l Oligo, e Mio):90; Lemau Intrusive Complex (e-m Oligo):104; Magavara Syenite (l Oligo?-m Mio):63; Mebu Beds (l Oligo-e Mio):91; Merai Volcanics (l Oligo):98; Modewa River Beds (l Oligo-Mio):65; Mount Turu Complex (Oligo?-e Mio):20; Nasananka Conglomerate (Oligo):43; Nebilyer Limestone (m Eo-e Oligo):22,33; Omaura Greywacke (m-l Oligo): 44,66; Padowa Beds (l Oligo-Mio):65; Prince Alexander Complex (E Cret-e Mio):20; Pundugum Formation (l Oligo?-e Plio):21; Sadowa Gabbro (l Eo-m Oligo):67; Sige Lele Gabbro (l Oligo?-m Mio): 63; Tibinini Limestone Member (l Oligo?-m Mio):32; Tinniwi Volcanics (l Eo-e Mio):109; Torricelli Intrusive Complex (L Cret-e Mio):20; Ulo Ulo Gabbro (l Oligo?-m Mio):63; Watuti Gabbro (l Oligo?-m Mio):63; Wulamer Beds (Eo-Oligo?)21; Yangi Beds (l Oligo?-m Mio):32

EOCENE

PALEOCENE

TERTIARY

CRETACEOUS

JURASSIC

TRIASSIC

PALAEOZOIC

(b) Unnamed Map Symbols

QUATERNARY

Q: 76,101; Qa: 6, 27, 28, 38, 49, 75, 76, 84, 93, 105; Qa_1: 28, 49; Qab: 93; Qav: 93; Qc: 6, 53, 75, 76, 86, 94, 102, 105; Qf: 7, 38, 84; Qh: 101; Qha: 6, 38, 49, 84; Qhc: 49; Qhl: 39; Qhw: 51; Ql 76; Qm: 6; Qp: 7, 39, 49, 86; Qpa: 51; Qpc: 49, 94; Qpg: 51, 85; Qphf: 38, 84; Qpm: 27, 85; Qpu: 51; Qr: 67; Qs: 6, 27, 38, 49, 53, 75, 84, 105; Qt: 28, 49; Qv: 93, 106; Qvy: 51; TQs: 29

PLIOCENE

Czu: (Mio?-Plio?): 104; Qpc (Plio?, Quat): 94; Tmi (Mio-Plio): 64; Tmn (1 Mio-1 Plio):55;Tp (Plio): 14, 56, 87; Tpa (Plio): 55; Tpi (Plio): 87, 107; Tpi (Plio): 107; Tpv (Plio): 76; Tpy (Plio): 57

MIOCENE

Czu (Mio?-Plio?): 104; Tlm (Oligo?-e Mio?): 91; Tm (Mio): 19, 31, 32; Tmsg (e-l Mio): 16; Tmi (Mio-Plio): 64; Tmn (1 Mio-e Plio): 55; Tms (1 Mio): 61; Tmsg (e-1 Mio): 16; Tmt (e-m Mio): 32; Tmtz (m-1 Mio): 31; Tmu (1 Mio): 60; Tmx (1 Oligo-e Mio): 31,65; Tou (1 Oligo-e or m? Mio): 43; Ts (e Mio?): 90

OLIGOCENE

Tlm (Oligo?-e Mio?):91; Tmx (1 Oligo-e Mio): 31, 65; Tom (1 Oligo?): 21; Tou (1 Oligo-e or m? Mio): 43; U (pre-Mio?): 24

EOCENE

Te (Eo): 33; Te (Eo): 68; Teh (m-1 Eo): 43

TERTIARY

Tu (Tert or older): 90

MESOZOIC

Mum (Mesoz?): 24

CRETACEOUS

Kl (E Cret): 35; Mb (Cret or older); 83; Md (Cret?):80

JURASSIC

Mb (Cret or older): 83