AGSO

MAGNETIC REPEAT STATION SURVEY OF PAPUA NEW GUINEA AN D THE SOUTH WEST PACIFIC MAY - JUNE

BY

A.M. LEWIS & A.J. MCEWIN

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AGSO

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Department of Primary Industries & Energy

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Magnetic repeat station survey of Papua New Guinea and the South West Pacific May-June 1993

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Abstract

A magnetic repeat station survey of six stations in the southwest Pacific was carried out in May and June of 1993. The survey was conducted to collect information on the geomagnetic secular variation in the region. The data will be used in the Australian Geomagnetic Reference Field (AGRF) model for epoch 1995.0 and also global models of the terrestrial magnetic field such as the International Geomagnetic Reference Field (IGRF).

The stations that were occupied were Port Moresby, Kavieng and Wewak (Papua New Guinea), Santa Cruz and Honiara (Solomon Islands) and Noumea (New Caledonia). Three new remote reference stations were established in Port Moresby to ensure the possibility of continuity of data over the period of expected disruption to the Port Moresby Magnetic Observatory in the near future. Two separate and full occupations of Port Moresby were made to ensure the measured station differences for the remote reference stations were consistent. All of the stations occupied, except Port Moresby, were last occupied in 1989.

At each station a three component fluxgate magnetic variometer and a proton precession magnetometer continuously monitored the magnetic field variation for at least three consecutive nights. Minute values of the four field elements, temperature and time were recorded on an IBM compatible personal computer and also on a six channel analogue chart recorder. The variometer data at each repeat station were calibrated with frequent and regular observations of the absolute strength and direction of the magnetic field with a declination inclination magnetometer and a proton precession magnetometer. Stations were upgraded where necessary.

The normal (quiet) field level for each station, the geomagnetic secular variation since the last occupation, as well as the observed values of the magnetic field and hourly mean values are presented in this report, together with a detailed description of the work carried out at each station.

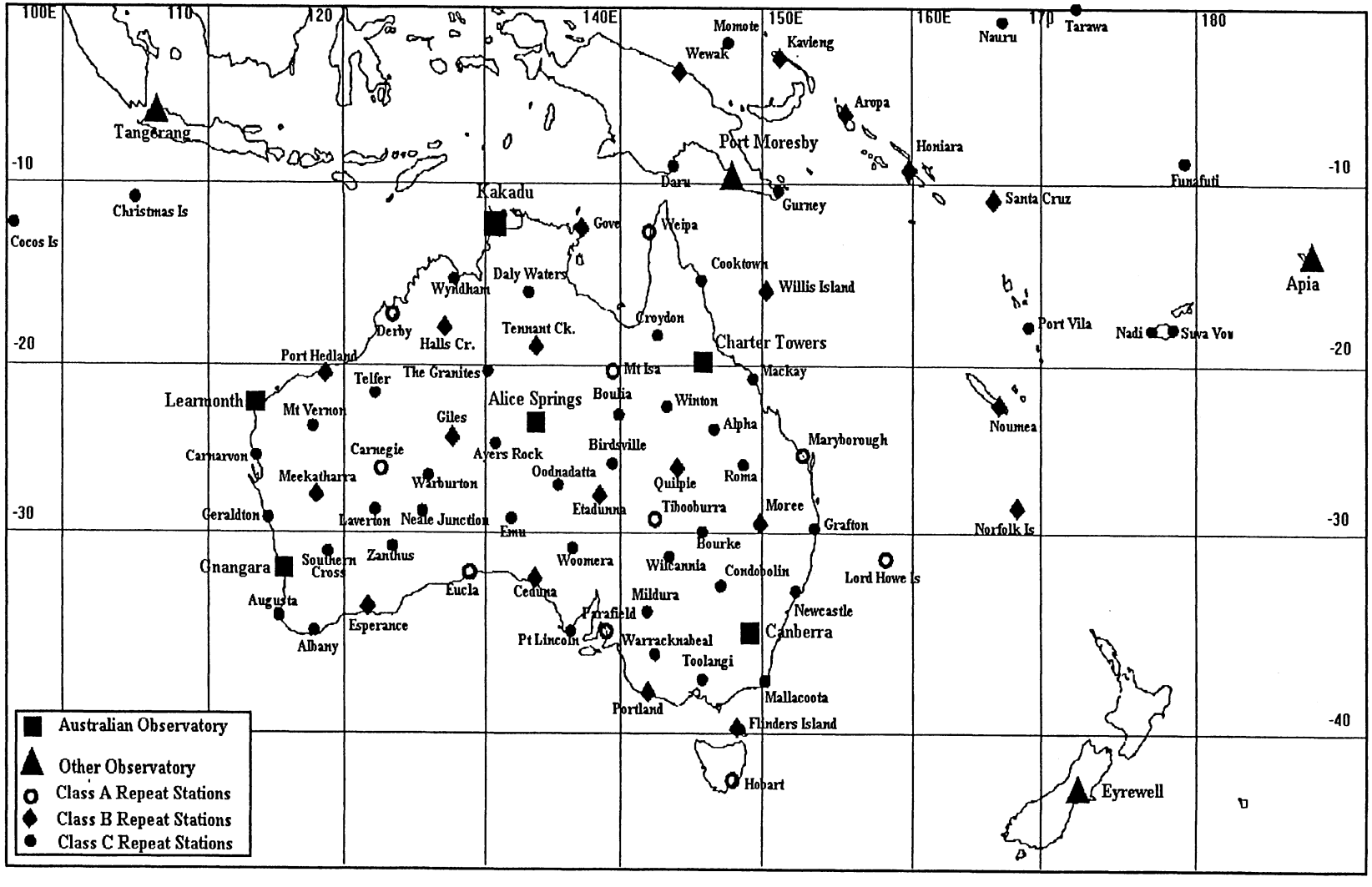

Figure 1. AGSO repeat stations and magnetic observatories in the Australian region.

Introduction

The Australian Geological Survey Organisation (AGSO) maintains a network of over eighty magnetic repeat stations throughout mainland Australia, its offshore islands, Papua New Guinea and the south west Pacific. Each of the stations are occupied to collect terrestrial magnetic secular variation and field strength data to first order accuracy. A repeat station survey is classified as "first order" only if absolute magnetic data are collected to magnetic observatory standards. A three component magnetic variometer must record continuously for at least two consecutive magnetically quiet nights in conjunction with numerous absolute observations of the Earth's magnetic field throughout the day to calibrate the variometer recording.

In previous years all the stations in the AGSO magnetic repeat station network were occupied on a five yearly cycle, with each station being visited once every five years. Recently, a new scheme for station occupations has been devised to more accurately track the magnetic secular variation. The station network has been subdivided into three categories, referred to as A, B and C. Group A, or the "super repeat stations" consists of 10 stations that are to be occupied every year. The super repeat stations, coupled with the existing Australian magnetic observatory network, provide approximately equidistant coverage throughout Australia. Group B contain stations that are to be occupied every five years and category C covers those stations to be occupied on a nominally ten yearly cycle. The locations of the magnetic repeat stations, and the subdivision into the three categories, together with magnetic observatories in the Australian region are shown on Figure 1. Each of the station occupations described in this report is of a group B (five yearly) station.

The geomagnetic secular variation and field strength data collected during the station occupations contribute to the production of the Australian Geomagnetic Reference Field (AGRF), a numerical model of the Earth's magnetic field in the Australian region. The data also make an important contribution to global magnetic field and secular variation modelling since the south west Pacific region is poorly represented by the global magnetic observatory network, with only a small number of observatories over a vast area.

The survey ran from 20 May to 30 June 1993 and the stations occupied were Port Moresby, Kavieng and Wewak in Papua New Guinea, Santa Cruz and Honiara in the Solomon Islands and Noumea in New Caledonia. The repeat station at Aropa, PNG is also a five yearly station however it was not occupied during this survey since official permission to visit Bougainville could not be obtained due to civil unrest.

Two separate occupations were made at Port Moresby because the magnetic observatory is under threat of contamination by a rapidly encroaching new housing development at the observatory's Tabletop site. A new magnetic and seismic observatory is being planned at Tabletop and three remote magnetic reference stations were established to ensure the possibility of continuity of magnetic measurements between the old and new observatories.

Survey Planning and Preparation

Administration

Planning for the survey commenced well before the intended departure date. May and June were chosen to carry out the survey since this is the time which promises the best weather conditions throughout the survey area. Once the approximate dates for the survey were decided upon an "Overseas Visits Program Bid" was submitted through the AGSO travel clerk. Once approved, this form is the necessary official permission to allow further organisation of the survey to go ahead.

Letters to the appropriate international governing bodies were then sent requesting permission to access the magnetic stations. A full list of addresses and contact numbers starts on page 28. As soon as official permission had been gained to undertake the survey the other administrative paper work was completed, such as "Formation of Field Party", "Overseas Travel Approval" and "Overseas Movement Requisition" forms.

Travel and Accommodation Arrangements

Travel arrangements were made through the AGSO travel agent (Ansett Australia). Several months were required to finalize flight details. Flights to destinations other than the usual Australian tourist or business destinations can be difficult to arrange through Ansett for a workable itinerary. Suitable flights within Papua New Guinea were advised by the Officer in Charge (OIC), Port Moresby Geophysical Observatory (PMGO), Mr. Ian Ripper, and booked from Canberra through the travel agents.

Accommodation was available at all stations. Within Papua New Guinea accommodation bookings were arranged by Ian Ripper whilst the Australian High Commission in the Solomon Islands provided help in booking accommodation for Honiara and Santa Cruz, and the Australian Consulate in Noumea arranged bookings for New Caledonia. A list of accommodation and hire cars used begins on page 30, together with addresses and contact numbers. Organising bookings personally would probably be faster and more efficient than going through the Australian Missions unless any special requirements need to be arranged. A copy of the full flight itinerary is set out in Table 1 on page 4. A return seat on the flight from Honiara to Santa Cruz for an assistant from the Solomon Islands Geological Survey was arranged and paid for in Canberra prior to departure.

Meals were available at all hotels except at Santa Cruz. Enough food for the occupation of Santa Cruz should be taken on the flight as there is only very limited produce available at Lata. At least half a working day in Honiara should be allowed for shopping for Santa Cruz, bearing in mind that most shops are closed on the weekend in Honiara except for those in Chinatown.

An official Government passport and visas were organised through the AGSO travel clerk. At least six to eight weeks should be allowed to organise travel documents. In 1993 an entry visa was required for Papua New Guinea and New Caledonia, the other countries visited provided tourist visas on arrival. Up to date advice on visa requirements can be provided by the AGSO travel clerk. An official government passport is preferable to a standard tourist passport since it may allow exemption from airport departure tax, or even the excess baggage fees in some countries.

Hire Cars

Commercial hire cars were booked at all stations except Santa Cruz, where no cars were available. The OIC, PMGO arranged car bookings within Papua New Guinea, the Australian High Commission assisted in the Solomon Islands, and the Australian Consulate booked a car in Noumea. In general four wheel drive utilities were used. A four wheel drive was essential to reach one of the repeat stations installed at the Port Moresby Observatory. Payment was made with Mastercard. Discounts were available for the Australian Government at some locations. It is essential that all car bookings are confirmed before arrival. Further details and contact numbers for organising hire cars begins on page 30.

At Santa Cruz a vehicle is necessary on immediate arrival to transport the equipment from the airport to the accommodation, and also at the completion of the survey to transport the gear back to the airport. This should be arranged in advance through the Ministry of Natural Resources (MNR) contacts. The MNR Fisheries Division provided a vehicle on arrival and the Provincial Government vehicle was used on departure. At all other times the only transport at Santa Cruz was by foot.

Table 1. Flight Time Table

Month	Date	Day	From	To	Times	Flight #	Accommodation
May	19	Wed	Canberra	Sydney	Driving	---	Airport Parkroyal
"	20	Thurs	Sydney	Port Moresby	08:35 - 14:15	QF-95	West Side Motel
"	27	Thurs	Port Moresby	Kavieng	10:05 - 12:30	PX-214	Kavieng Hotel
June	03	Thurs	Kavieng	Manus Island	12:55 - 13:45	PX-214	Transit only
"	03	Thurs	Manus Island	Wewak	14:20 - 15:15	PX-213	Sepik Internat.
	08	Tues	Wewak	Port Moresby	07:00 - 09:05	PX-125	West Side Motel
"	12	Sat	Port Moresby	Honiara	09:00 - 12:20	PX-82	Airport Hotel
"	14	Mon	Honiara	Santa Cruz	11:15 - 14:05	IE-118	Gov Rest House
"	19	Sat	Santa Cruz	Honiara	10:20 - 13:20	IE-119	Airport Hotel
"	23	Wed	Honiara	Port Vila	16:20 - 18:10	IE-710	Windsor Internat
"	25	Fri	Port Vila	Noumea	09:00 - 10:00	NF-235	Tontoutel Hotel
"	30	Wed	Noumea	Sydney	12:20 - 14:20	AF-147	Transit Only
"	30	Wed	Sydney	Canberra	16:55 - 17:40	AN 647	

Health

Vaccinations were arranged with the Commonwealth Medical Officer through the AGSO personnel section. Typhoid vaccinations were required as well as a course of anti malaria drugs. These should be arrange at least six to eight weeks prior to departure since some vaccines require administration in doses separated by several days and there are minimum allowable times between receiving some vaccines and commencing anti malaria drugs. Daily 100mg doses of doxycycline were prescribed as the appropriate malaria prophylactic for Papua New Guinea and the Solomon Islands.

Finances

In previous surveys finances have been organised though travel allowance and petty cash advances for meals, accommodation and purchases, fund transfers through Australian Embassies to cover the cost of hire cars, and Miscellaneous Charge Orders (MCO's) to cover excess baggage costs. The complicated and time consuming arrangements required to organize these various forms of payment were greatly simplified for the 1993 survey when permission was granted to use a Commonwealth Government Corporate Mastercard throughout the survey. The finance section allowed the card to be used to pay for hotel accommodation, hire cars and excess baggage. Travel allowance for meals and incidentals was received as an advance which was converted to Australian Dollar travellers cheques. Travellers cheques were accepted in all the countries visited. A small amount of each appropriate foreign currency was also carried and proved most useful since travellers cheques cannot always be cashed immediately.

The Mastercard proved to be very convenient. All hotels, hire car companies and airlines that were used accepted Mastercard except for the accommodation in the Government Rest House at Santa Cruz. Solomon Islands Airlines in Honiara were not particularly happy with Mastercard initially, but when pressed accepted it for payment of excess baggage. No problems were

experienced elsewhere with the use of Mastercard. A suitable credit limit was arranged beforehand to allow for all foreseeable expenses to be covered.

Equipment Freight

The equipment was transported as excess baggage to all locations except for the first and final legs of the journey. The initial journey from Canberra to Sydney was made by AGSO vehicle to transport the equipment and for the final leg from Noumea to Canberra the equipment was sent as unaccompanied air freight with Air France. It is less expensive to send the equipment freight on the final leg when there are no time constraints. The airline with which one is flying usually gives freight discounts when a flight ticket is presented. At all other times the equipment was checked in over the counter and transported as excess baggage. Excess baggage costs are a major component of survey finances but it ensures that there are no delays with customs and also increases the probability that the equipment will be carried on the same aircraft with the survey personnel so that work can commence immediately upon arrival. This is very important given the tight scheduling and the few flights to many places on the survey (some locations only have one flight per week). The possibility of freighting the equipment from Australia to Papua New Guinea was considered, but was not recommended by the OIC Port Moresby Observatory because of the strong probability of very long delays in the Customs bond store at Port Moresby. All excess baggage was paid for using a Commonwealth Government Corporate Mastercard.

It is important to forewarn airlines of the large amount of excess baggage. The OIC, PMGO sent a letter to the Public Relations Manager of Air Nuigini requesting the co-operation of the respective Air Nuigini port managers at the airports to be visited. This proved most beneficial. At each location the port managers were approached well before departure time to request their assistance. The traffic manager of Solomon Airlines at Henderson Airport was also contacted as was the manager of Air Vanuatu in Pt Vila. Despite all these precautions it was still imperative that the equipment was watched very closely at all times to ensure that it was loaded. The aircraft was only boarded once all the equipment had been seen to have been loaded. Only once during the survey was some of the equipment left behind, on a flight between Port Moresby and Kavieng. Fortunately there was a flight later that evening on which the rest of the boxes were carried.

The smallest aircraft on the survey was a Twin Otter between Honiara and Santa Cruz. For this leg of the survey the equipment was reduced to an absolute minimum volume. One aluminium box and personal luggage was left behind at the hotel in Honiara for this trip. Excess baggage costs for both legs of the return trip to Santa Cruz should be pre-paid at Henderson airport before departure since there are no credit card facilities on Santa Cruz.

International Customs Services

Letters were sent to all appropriate customs services forewarning of the arrival of the equipment and requesting advice on procedures for temporary importation and exemption from import duty. Some of these letters were not answered. The New Caledonian customs service advised that a carnet ATA document would be necessary to allow the temporary importation of the equipment. Advise was sought from the Australian Customs Service and a complete itemized list of all the equipment, together with serial numbers and bar codes was provided to them. All the equipment was taken to the Fyshwick office of the Australians Customs Service where it was spot checked against the list. The list was then annotated and officially stamped and a copy retained by Customs. Copies of the official customs list were useful to present to foreign customs services.

Despite any advice to the contrary a carnet ATA should be obtained to ensure the trouble free entry of the equipment into New Caledonia. Without a carnet considerable difficulty was experienced

getting the equipment passed by the French Customs Service, made even more difficult by the language barrier. A carnet should be arranged through Australian Customs prior to departure, this apparently can take several weeks for the appropriate paper work to be approved, however it would be worth the effort.

At no port was all the equipment thoroughly checked by customs. Usually a copy of the complete equipment list and a brief search of one or two items was sufficient. In Port Moresby a "Personal Undertaking to the Collector of Customs" form was filled out. A rough idea of the total value of the equipment is also occasionally required. Care should be taken to remove all residual soil from tent pegs and other equipment before entering a new country to comply with quarantine regulations. Customs duty was not paid at any location.

Equipment Preparation

The equipment for the survey was tested under pseudo-field conditions at the Canberra Magnetic Observatory for several days prior to departure to ensure that it was in good working order and operating correctly. A full description of the equipment can be found below on page 7. A complete list of the equipment and packing order is set out on page 34.

The equipment was trial packed and each box weighed. It is important that no single item weigh more than 30 kilograms for commercial flights within Australia, otherwise that item must be sent as freight. This standard was assumed to hold for overseas flights. It is also the limit for easily moving individual boxes by hand with no assistance.

Suitable power point adapters were arranged for New Caledonia, all other countries visited used standard Australian three pin plugs

Instrument Comparisons and Corrections

All the absolute instruments were compared to the Australian Standard magnetometers at the Canberra Magnetic Observatory both before and after the survey to determine instrument differences. The results of the comparisons are set out in Table 2 on page 7. Instrument corrections on page 6 were derived from these instrument differences.

The standard instruments used at the Canberra Observatory to define the Australian magnetic standards for declination (D) and total field strength (F) are the Ruska 4813 declinometer and the MNS2.3 proton precession magnetometer (PPM). Recent observatory calibrations and comparisons of the Ruska against the range of Declination-Inclination magnetometers (DIM) the geomagnetism group now owns indicates that the correction of -0.3 minutes of arc applied to the Ruska is not required. The D comparisons in Table 2 were completed before this confirmation and incorporate this adjustment.

Instrumental differences for I based on the total field strength (F) from the MNS2.3 PPM and the horizontal field strength (H) derived from quartz horizontal magnetometer (QHM) 461 incorporate the correction for QHM 461, i.e. the instrumental value of H has been corrected to the international standard derived from recalibration of the Canberra Observatory standard set of QHM 460's by the Danish Meteorological Institute. The standardised H and F values were then used to define an I standard using the relationship H=Fcos I, against which the DIM value of I was compared.

Adopted Instrument Corrections

Fs=E770/211+**1.0**nT
Ds=DIM 308887/220-**0.3'**
Is=DIM 308887/220-**0.1'**

Table 2. Instrument Comparisons

Declination Inclination Magnetometers

Observatory	Date	Instrument(s) A	Instrument B	Inst A - Inst B	
				D	I
Canberra	10-May-93	Ruska 4813	308887/220	-0.61	-0.10
		QHM 461 MNS2.3/X			
Canberra	22-Jul-93	Ruska 4813	308887/220	-0.63	-0.12
		QHM 461 MNS2.3/X			

Proton Precession Magnetometers (F)

Canberra	10-May-93	MNS2.3/X	E770/214	1.5
Canberra	22-Jul-93	MNS2.3/X	E770/214	1.3
Canberra	10-May-93	MNS2.3/X	E770/211	1.6
Canberra	22-Jul-93	MNS2.3/X	E770/211	1.6

Units for D and I are in minute of arc. Units for F are in nanotesla (nT)

Equipment

Variometer Equipment

Variations in the magnetic field were monitored using a four component variometer and recording system. An EDA FM-105B three component portable fluxgate magnetometer was used to measure three nominally orthogonal components of the Terrestrial magnetic field and an Elsec E820 proton precession magnetometer (PPM) to measure the total field. The temperature dependence of the fluxgate was monitored by recording the temperature inside the fluxgate sensor with a thermistor connected to a Doric temperature trendicator.

The ±10 volt continuous analogue output from each of the three channels of the fluxgate variometer and the analogue temperature output from the Doric Trendicator were digitized with an EDAS-2 analogue to digital data logger and sampled at a rate of 1 Hz. The total magnetic field was sampled nominally every 10 seconds. Data were averaged to minute values and recorded in digital format with a 3100SX Toshiba laptop computer running the background magnetic acquisition program MACQ version V0103 and the foreground plotting and display program MACQMON (Crosthwaite, 1994). These are the standard magnetic acquisition programs run at many of the magnetic observatories managed by AGSO within Australia and Australian Antarctic Territory. Timing for the digitally recorded system was provided by the computer's internal DOS clock.

The analogue outputs from the fluxgate, E820 PPM and Doric Trendicator were also recorded on a six channel Texas Instruments Tigraph chart recorder. The sixth channel on the chart recorder monitored hour mark timing pulses produced from a digital clock constructed at AGSO. This provided timing for the analogue chart recording. The chart record was maintained as a backup to the digital recording system.

The EDAS-2 data logger was powered from the external battery inputs with a 12 volt plug pack. The E820 was powered from an 18 volt DC supply constructed at AGSO and the clock was powered with a 12 volt plug pack. The Toshiba computer has its own DC power pack. All the other variometer equipment was connected directly to the mains supply via a "Squeaky Clean" power line filter and distribution board.

The variometer and recording equipment is shown in schematic form in Figure 2.

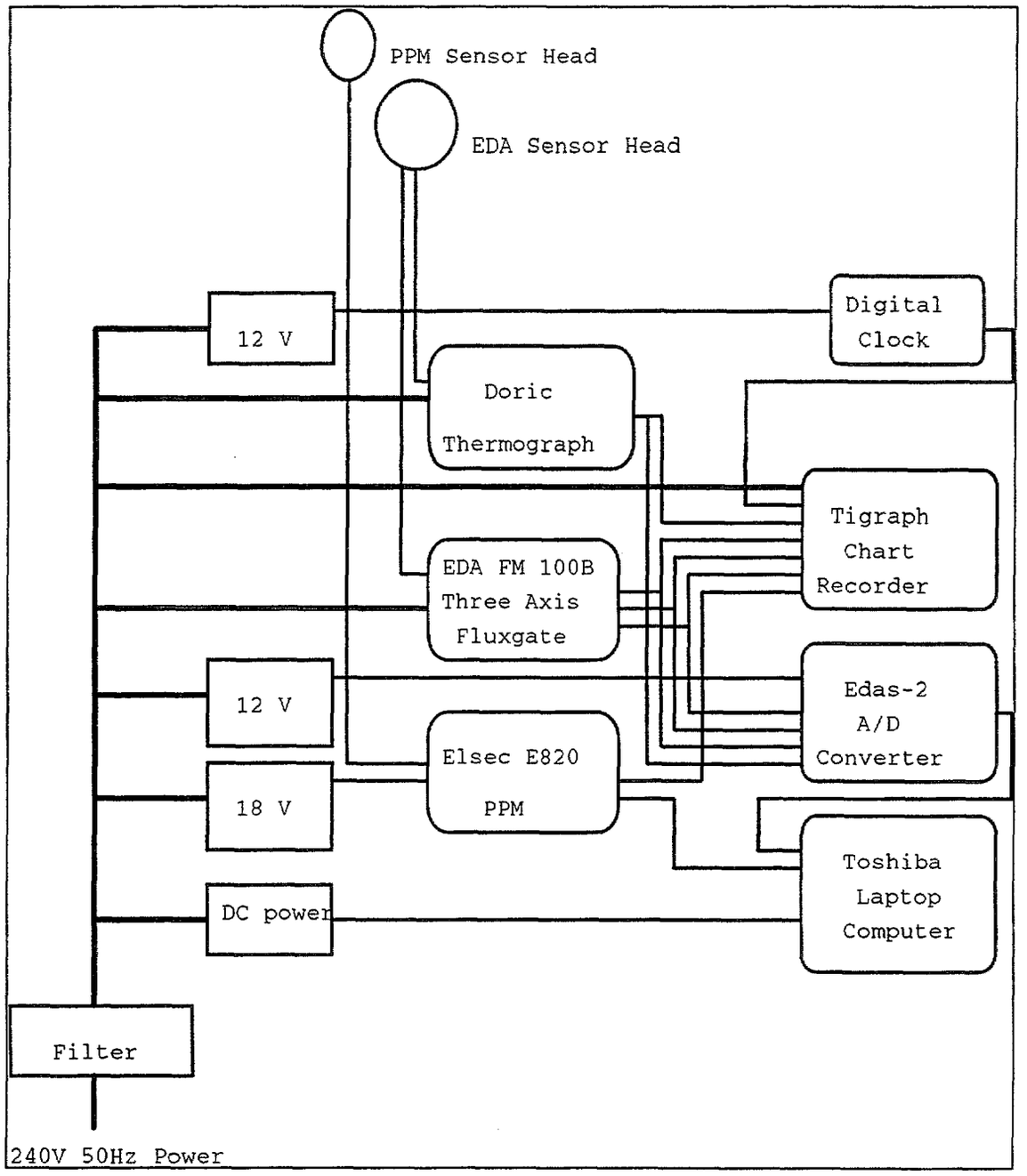

Figure 2. Variometer and Recording Equipment Schematic.

Absolute Equipment

Absolute values of the Earth's magnetic field were measured over the first order station plaques frequently and regularly throughout the station occupation using the magnetic absolute instruments. These observations were used to calibrate the variometer recordings. A Declination-Inclination Magnetometer (DIM) was used to measure declination and inclination and a PPM was used to measure the total field strength. These three elements allow all other elements of the magnetic field to be resolved without ambiguity.

The primary DIM was an Elsec 810 unit, serial number 220 with the fluxgate element mounted on a Zeiss 020B non magnetic theodolite, serial number 308887. An Elsec E770 PPM was used, serial number 211.

Backup instrument DIM 213/311542 and PPM E770/214 were also taken on survey in case the primary instruments malfunctioned. All instruments were compared to the Australian standard instruments at the Canberra Magnetic Observatory both before and after the survey. Instrument comparisons and corrections are discussed above on page 6. The DIM theodolite was also used to make observations of the sun for azimuth and rounds of angles. Two non magnetic tripods were used to mount the instruments during observations.

Auxiliary Equipment

There is a large amount of other equipment required to successfully complete a first order station occupation. A second Toshiba laptop computer was used for on site processing of observations at the end of every day of the occupation to monitor the quality of the occupation. An observing shelter made of a light coloured two man tent fly mounted on tall poles is essential to protect the instruments and observer from sun and rain during observations. Other essential items of equipment are a short wave radio receiver to monitor international time services, spare parts such as fuses, batteries, brass station plaques, foot pipes for the tripod footpads, plastic bags to protect instruments from rain, and stationery. Equipment manuals and electronic testing and repair equipment is also vital, as are tools such as hammer, trowel and screwdrivers. The full list is presented on page 35.

Equipment Performance

Conditions on the Papua New Guinea and Pacific leg of the survey are generally very hot and humid, perhaps amongst the most extreme under which the equipment is required to operate. Most of the equipment performed well throughout the survey but some problems did arise.

The Elsec E820 variometer PPM's did not perform well at any of the stations. Low signal strength and very scattered readings were typical of both E820 units. The scatter was such that the analogue recording of the total field data was sacrificed so that the other traces would not be overwritten and obscured. Typically there were one or two good readings every minute, but the remaining scattered readings caused the average for that minute to be unrepresentative of the true field strength. The acquisition software filtering was set to accept only a narrow band of F values in an attempt to retain these few good readings and discard the scattered ones, however this did not prove effective. It was later discovered that the coils in one of the E820 sensor heads had become discontinuous due to a faulty crimp connection on the aluminium wire making up the coil, an instrument design fault. The secondary sensor head was also checked and found to be in good condition. The reason for the poor performance when using the secondary head is not certain, though a dry solder joint in the head coils could explain the intermittent behaviour.

The Texas Instruments Tigraph 100 chart recorder failed to operate on setup at the second occupation of Port Moresby. The problem was found to be a blown capacitor on the power supply board which was rectified by replacing the capacitor. The recorder operated well for the remainder of the survey. The chart recorder is a heavy bulky instrument that is difficult to pack. Replacement parts are difficult to obtain and hence the instrument should be upgraded to a smaller, lighter more modern piece of equipment.

The Doric Trendicator failed to produce analogue output, and hence digital output, for the last three station occupations. The problem could not be identified in the field. But was later found to be a faulty connection on the circuit board. The fault may have been caused by very rough handling of boxes during aircraft loading on the flight to Santa Cruz.

The absolute instruments were generally reliable, although every effort must be made to ensure that the instruments remain dry. The E770 absolute PPM gave several periods of scattered data due to unavoidable rain on the electronics unit. Batteries must be regularly monitored and replaced. The

primary DIM theodolite (serial number 308887) is not suitable for measuring inclinations greater than -19 degrees (ie -19 to +19) since the vertical circle is only numbered to 19 degrees. For inclinations of more than about -23 degrees it is more convenient to use the diagonal elbow viewing attachment in order to make circle readings but the configuration of the DIM cable makes using the attachment difficult. The plastic steep sighting prism attachment was used routinely.

Procedures

Variometer Setup

The variometer equipment was set up close to the repeat station sites. Finding a suitable site for the variometer was one of the first tasks of an occupation. The important requirements for a variometer site are the availability of 240 volt power continuously for the duration of the occupation, the site must be free from any transient artificial magnetic interference, it must be weather proof and secure (very important in Papua New Guinea) but accessible 24 hours a day. There are often suitable buildings at the airports although some sites proved more difficult than others, see the individual occupation reports for details.

The EDA FM-100B fluxgate sensor consists of three nominally mutually orthogonal fluxgate elements. These were aligned to measure approximations to the horizontal intensity (H), the declination (D) and the vertical intensity (Z) of the Earth's magnetic field. To install the sensor a round hole approximately 15 cm deep was dug, big enough in diameter to hold the sensor head and allow room to adjust the various screws on the base of the sensor. The EDA sensor head was mounted on a 10 cm non magnetic spike driven vertically into the ground. The sensor head was then leveled on the spike using the adjustable thumb screws. The head was rotated to null the output of the second channel (Y) on the analogue dial of the FM-100B electronics unit. This aligns the first channel (X) along the magnetic meridian at the time of setup and the second channel (Y) perpendicular to the horizontal intensity which, for small changes in the field, can be approximated to measuring the horizontal intensity and declination. The third variometer channel measures the vertical component (Z) provided the head is exactly level. The entire sensor head was then covered by a 44 litre non magnetic plastic esky to retard the rate of temperature variations. The base of the esky was secured with soil and foliage to prevent the free movement of air. A three man tent fly was erected over the esky to protect the sensor from direct sun and rain. The EDA sensor was always set up at the limit of the EDA cable (30 metres) as far as possible from any disturbance caused by the building in which the recording equipment was housed.

The E820 proton precession magnetometer head was mounted at least 10 metres away from the EDA head on a three piece non magnetic pole driven into the ground and secured with three guy ropes for stability. The head was oriented magnetic north and had an approximate height above ground level of 1.2 metres. The head was covered in a plastic bag to protect the electrical contacts from the rain.

The computer based data acquisition system MACQ (Crosthwaite 1994) recorded the three channels from the EDA fluxgate, the temperature inside the EDA sensor head and the total magnetic field strength from the E820 PPM, together with the universal time (UT) every minute.

A recording minute is centred on the minute and runs from 29 seconds to the minute until 30 seconds past the minute. Each minute value is comprised of an average of the (usually) sixty readings of the three fluxgate channels and temperature and six total field readings. Timing was provided by the computers internal clocks. There is a constant drift associated with the computer clocks but the acquisition software can correct for this and the clocks were checked at least twice daily. The

maximum timing error associated with the variometer recordings is estimated at one second. A record of variometer recordings made at each station is set out in Table 3 below.

Absolute Observations and Station Differences.

Absolute values of the total field, declination and inclination were measured using a DIM and a PPM as described above. The DIM theodolite was mounted on a non magnetic tripod over the station marker cross on the magnetic station plaque using the optical plumb for alignment. The instrument was set up at a height such that the centre of the DIM telescope is 1.60 metres above the plaque, to the nearest centimetre, when the vertical circle is set in the 90 or 270 degree position. Total field measurements were made at a secondary pier, consisting of the second tripod not more than 10 metres from the magnetic station. The difference in the scalar total field strength between the magnetic station and the secondary F pier was determined by measuring the total field strength at both piers in a symmetric series of total field observations at the beginning and end of the occupations. The measured difference between the piers was used to correct the PPM observations to the main station during data processing. Three brass footpad pipes were hammered into the ground at the site of the secondary pier in which to mount the tripod to ensure that the position of the pier did not alter during the occupation. The tripod legs were marked to ensure the secondary pier was always set up at the same height. The PPM head was mounted in the standard bolts down configuration on a plastic stand designed to raise the centre of the PPM sensor head to the same height as the DIM when on the same tripod.

A standard set of observations was made up of a sequence of observations FDIF. Where F represents one minute of observations of the total field (from 29 seconds to the minute to 30 seconds past the minute) usually 6 individual F readings, sampled at the same time as the variometer system. D represents a determination of declination with the DIM from four individual readings of the horizontal circle and I a determination of inclination with the DIM from four readings from the vertical circle. A set of mark readings (sensor up and sensor down) are taken at the beginning and end of every DI sequence. Four repetitions of this sequence make up a set of observations, unless the set is interrupted by bad weather or magnetic interference. The PPM was configured in auto re-cycle mode for the observations, negating the necessity to depress the read button to initialize a reading.

Temperature observations were recorded on the absolute observing forms several times each day. The temperature inside the variometer fluxgate sensor head, as displayed on the Doric Trendicator, was recorded at 10 second intervals over one recording minute. Typically a total of approximately ten to fourteen temperature observation were made at various times throughout a station occupation.

Magnetic observations were made on secondary magnetic stations to determine the station differences. The observations were made without a secondary F pier and a standard set of four observations to determine a station difference followed the sequence FFDI, DIFF, FFDI, DIFF, all made in succession on the same tripod over the secondary station plaque. Measured station differences are set out in Table 4 below.

Observations at all stations were always made under the observing shelter to protect the instruments from sun and rain as much as possible. All observations were recorded manually on the observing forms on a non magnetic penciling board.

Generally, the secondary station was used as the azimuth from the primary station and vice versa. Windsocks and other marks which have been used as primary azimuth references in the past, can be shifted between occupations, particularly in the tropics were cyclones are common. A one metre length of inflexible small diameter aluminium pole was set up over the middle of the plaque on

the secondary stations with guy ropes and set to the vertical with a spirit level. The pole was painted alternating blue and white to make it easily visible in most conditions. This made a good mark.

Table 3. Magnetograph Recordings

Location		Start Time (UT) hh:mm dd/mm/yyyy	End Time (UT)	Remarks
Honiara	A	02:51 20/06/1993	22:40 22/06/1993	No T no useful F A+D
	D	02:47 20/06/1993	22:43 22/06/1993	3.5 hrs XYZ lost A+D
Kavieng	A	00:49 28/05/1993	00:01 01/06/1993	no F data, noisy T
	D	00:49 28/05/1993	00:04 01/06/1993	F unusable 186 mins loss X
Noumea	A	06:25 25/06/1993	00:02 29/06/1993	No F no T data
	D	06:26 25/06/1993	00:03 29/06/1993	No T, F unusable
Port Moresby	A	00:47 22/05/1993	02:56 26/06/1993	no T 6hrs XYZF loss F noise
	D	00:33 22/05/1993	02:58 26/06/1993	4.1 hrs XYZFT loss
Port Moresby	A	05:29 10/06/1993	01:16 11/06/1993	No F data, recorder faulty
	D	04:05 08/06/1993	01:18 11/06/1993	F unusable
Santa Cruz	A			No data recorded
	D	21:38 14/06/1993	00:27 18/06/1993	F unusable, no T data
Wewak	A	07:07 04/06/1993	22:15 06/06/1993	no F data
	D	07:08 04/06/1993	22:16 06/06/1993	F unusable

A=Analogue data
D=Digital data

Table 4. Station Differences

Station 1	Station 2		Station 1 - Station 2							
			X	Y	Z	F	H	D	I	# obs on
			nT	nT	nT	nT	nT	mins	mins	Station 2
Honiara B	Honiara C	21-Jun-93	-57.0	40.7	-47.7	-18.7	-49.5	4.8	-5.5	4
Kavieng C	Kavieng D	21-May-93	-1.0	-17.0	8.3	-5.7	-2.9	-1.6	0.6	4
Noumea B	Noumea C	26-Jun-93	36.1	41.2	-44.7	62.9	44.4	3.4	0.2	4
Port Moresby SE	Port Moresby A	24-May-93	3.5	-7.4	54.8	-27.9	2.7	-0.7	3.8	4
Port Moresby SE	Port Moresby A	9-Jun-93	3.0	-8.6	53.1	-27.5	2.0	-0.8	3.6	6
Port Moresby SE	Port Moresby B	25-May-93	-93.3	-40.2	195.5	-189.2	-97.7	-2.8	8.7	4
Port Moresby SE	Port Moresby B	10-Jun-93	-92.5	-46.6	192.4	-187.0	-97.2	-3.4	8.6	4
Port Moresby SE	Port Moresby C	25-May-93	-48.9	14.5	212.8	-156.3	-46.9	1.9	12.1	4
Port Moresby SE	Port Moresby C	10-Jun-93	-48.0	6.2	209.6	-154.6	-46.9	1.1	11.9	4
Port Moresby SE	Port Moresby NM	11-Jun-93	-	-	-2.6	4.3	3.4	-	0.0	4
Santa Cruz A	Santa Cruz B	16-Jun-93	-1.3	-32.8	29.4	-21.3	-7.2	-3.1	1.8	4
Wewak F	Wewak E	5-Jun-93	20.1	-17.1	10.7	12.6	18.5	-1.8	1.5	8

Other Observations

Other work routinely undertaken at the magnetic stations include observations of the sun for azimuth at the main station, and other stations as required. As mentioned above the azimuth mark from the primary station is usually the secondary station, and vice versa, hence the azimuth from the secondary station is taken to be 180 degrees different from the azimuth mark from the primary station. Morning and afternoon sun observations were made when possible to determine (or check) mark azimuths. Occasionally overcast weather conditions prevented a morning or afternoon pair of observations being made. In this case at least two sets of sun observations were made when possible, perhaps both in the morning or both in the afternoon. The results of sun observations at all stations are set out in Table 5 below. The results are not necessarily the adopted azimuths used for the

reduction of the observations. Adopted azimuths are shown on page 38. Station co-ordinates used in calculating the sunshot data are presented in Table 6.

Co-ordinates for Kavieng C, Wewak E and Honiara C in Table 6 are derived from distances and azimuths to the other magnetic station. The distance Honiara B to Honiara C was estimated at 200m hence the co-ordinates for Honiara C are approximations only. Co-ordinates and elevations for Port Moresby A, B, and C were measured with a global position system (GPS) unit and a barometric altimeter. The co-ordinates quoted for these three stations have not been converted to the Australian Geodetic Datum. Elevations at Wewak are estimates based on reference levels of nearby permanent survey marks.

Table 5. Sun Observations

Station	Date	Mark Description	Azimuth (° ′ ″)
Port Moresby A	09/06/1993	TDC LH distant power pylon to east	102 11 13
Port Moresby B	25/05/1993	TDC EM-TV TX tower on hills to south	244 16 42
Kavieng C	29/05/1993	Station D	354 53 02
Wewak F	04/06/1993	Station E	272 21 46
Santa Cruz A	17/06/1993	Station B	074 36 33
Honiara B	21/06/1993	Station C	303 03 04
Noumea B	26/06/1993	Station C	241 26 03

Table 6. Station Co-ordinates

Station	Latitude	Longitude	Elevation
		(East of Greenwich)	(metres)
Noumea NOU			
B	-22 00 35	166 11 58	09
C	-22 00 39	166 11 52	11
Kavieng KAV			
C	-02 34 48	150 48 18	--
D	-02 34 39	150 48 17	--
Port Moresby PMG			
SE	-09 27 27	147 09 33	--
A	-09 24 29	147 09 30	120
B	-09 25 52	147 13 00	35
C	-09 25 55	147 12 59	33
Santa Cruz SCZ			
A	-10 42 48	165 47 34	02
B	-10 42 44	165 47 43	02
Wewak WEW			
D,F	-03 35 12	143 40 06?	05
E	-03 35 12	143 40 00	05
Honiara HON			
B	-09 25 25	160 02 48	10
C	-09 25 21	160 02 43	10

A round of angles at every magnetic station was read to determine azimuths of prominent reference marks around the station. The primary azimuth reference mark for the station was always included in the round of angles. Azimuths were determined from the known azimuth of the reference mark and the calculated angular differences between other marks. Azimuths calculated from the rounds of angles are shown on page 38.

A local total magnetic intensity survey was conducted around the primary and secondary stations at all locations to a distance of 25 metres in the four cardinal geographic directions. Sample spacings were 0.5 metres from 0 to 5 metres, and then 5 metres from 5 to 25 metres. The direction of the survey lines was determined from a compass bearing and the known declination of the site to the nearest degree. Station spacings were determined by laying out two 50 metre tapes marked at 10cm intervals along the lines of survey. The PPM sensor head was held on a staff at a height of 1.6 metres above the ground. The survey generally requires two people, one to hold the staff and one to carry the PPM console and record the numbers. This method ensured that the magnetic effect of the PPM console is reduced to a minimum by keeping it as far as possible from the sensor head. Systematic repetition of readings over the station allow the data to be corrected for magnetic variations in time. The results of these surveys are kept with the station descriptions at AGSO.

The vertical gradient of the total magnetic field was measured at each station by taking a symmetric series of one minute PPM observations over the station at three different tripod heights, the standard height of 1.6 m, the maximum height of the tripod and the minimum height of the tripod.

Colour print photographs were taken of the stations and surroundings to aid in location and identification for future occupations. Stations were marked with stakes where appropriate.

Stations and station descriptions were upgraded were necessary. At the completion of the survey all stations occupied were full concrete triangles enclosing plaque and footpads.

Field Data Reductions

All data were reduced at the completion of the days observations using the second laptop computer and a suite of software programs written for the purpose. Sun observations for azimuth were calculated, rounds of angles computed and total field surveys reduced and checked. Magnetic observations were entered onto file and reduced. Variometer parameters (scale values and baselines) for each channel were calculated and checked. The field reduction programs make the assumption that the variometer is set up to record the horizontal, declination and vertical components of the magnetic field.

All processing programs read from disk files so once the data were entered it was a simple task to check or correct with a text editor. Daily reductions of data allowed any problems to be quickly identified and suitable action taken before the station occupation was completed. This was particularly important as the survey was running to a tight schedule defined by aircraft flights.

A common problem identified during data processing was the need for more observations during the middle of the day to obtain a maximum range in the daily variation of the Z component in particular to allow accurate scale values to be determined through regression analysis. Baseline shifts can be identified and the baseline scatter used as a measure of the quality of the occupation. A full list of magnetic observations made on the survey are presented on page 39.

Station Occupation Reports

Honiara B, C

20-22 June 1993, AML

Contacts:
The Director, Geological Division, Ministry of Natural Resources, P.O. Box G24 Honiara, Solomon Islands. (Mr. Don Tolia in 1993 Ph. 0011 677 21 521 Fax 0015 677 21 245)
The Director, Civil Aviation Division, Ministry of Tourism and Aviation P.O. Box G20 Honiara

Solomon Islands. (Ph 0011 677 30 567, Fax 0015 677 30 775)
The Airport Manager is Mr. Michael Anita Ph 0011 677 30 561 at work, 30 963 at home.

Assistant: Bobby Kelly, MNR

Setting Up:

Problems were experienced in finding a suitable place to set up the equipment. After inspecting the Air Transport Ltd. hangar which is the western most of the airport buildings, the junk yard/repair shop just outside the airport fence near the hangars, the demountable buildings at the eastern end of the airport buildings and the Airport Hotel, none were found to be suitable. Initially it was arrange to set up the equipment in the office of the Air Transport Ltd. hangar and site the heads outside the airport fence in the long grass, however on further investigation and discussion the owner of the junk yard revealed his intention to move several large car and truck bodies during the occupation (less than 20 metres away from the proposed site) also there was a lot of activity with the Air Transport helicopter and fuel drums being moved about. Magnetic gradients in the area were very large, possibly due to the proximity to the airport fence and the metallic objects in the junk yard. For these reasons it was decided to find an alternative location. The equipment was finally set up in the rock store house behind the offices of the Ministry of Natural Resources Geological Division (MNR). This location is in town, about 15 kilometres from the airport, and as such quite inconvenient since the accommodation was only 2 minutes from the airport but no other satisfactory site could be located. The rock store is well below the main office area and is seldom visited. The sensor heads were set up on the flat area next to the store and away from the access gate. Power was taken from the seismological office via two long extension cables.

In previous occupations the equipment has been set up in a tent at the airport, taking power from the western most hangar at the airport. Prior to occupying Santa Cruz every effort was made to organise a tent from the MNR however it turned out that MNR do not have any suitable tents and none could be found to purchase in Honiara. In future occupations it may be worth considering posting a suitable tent to the MNR beforehand for use during the survey.

Equipment:

Neither the Doric thermograph nor the E820 PPM functioned properly. All other equipment operated well. There were several power failures, these are common in Honiara and especially frequent during the construction of the new highway to the airport. Several hours of data were lost.

Azimuth Marks: Station C from B, station B from C.

Observations:

Station B was occupied as the primary station. Twenty six observation on B, four on C. Morning and afternoon sunshots on station B. Round of angles, local F and total field vertical gradient surveys on both B and C.

Station Condition and Upgrades:

Both station are full concrete triangles, plaque and footpads in good condition. Both were easily found, though B was completely covered by tall grass. A search for station A was made but was not successful.

Comments:

There was some confusion as to the correct procedures to adopt when planes were landing. A hand held VHF radio was collected every morning from the airport authorities to allow contact with the control tower and clearance to cross the runway. Faulty batteries in the radios seldom lasted for more than half hour if a listening watch was kept as requested. The primary point of confusion hinged on whether the observing shelter should be taken down or left up during aircraft movements. When the 737-400, the flag ship of the Solair fleet came in to land, the tent was taken down well before hand, as requested, but the pilot was unhappy with us being in the vicinity of the station and so we were asked to leave on very short notice for the landing. We were then told by airport authorities that the shelter could remain up when he took off, however the pilot again requested that we take it down and vacate the area. Every effort was made to avoid being near the airport when the 737 was in the area on the subsequent days of the occupation. The local flights, Twin Otter and Islander aircraft posed no such problems. There is no cone line at Henderson Airport. If there were cones it may minimize the confusion for all concerned. The primary station is 44 metres from the edge of the runway, and under most circumstances should not cause any problem for incoming and outgoing aircraft.

Kavieng C, D

28 May - 01 June 1993 AML

Contacts:
The Assistant Secretary (airports) Department of Civil Aviation P.O. Box 684 Boroko, Papua New Guinea. (Ph 24 4400, Fax 29 2963 Mr. Noga Itana)
The Officer In Charge, Kavieng Airport, Department of Civil Aviation, P.O. Box 53, Kavieng, New Ireland, Papua New Guinea
(Mr. Andrew Nemar Ph 0011 675 94 2075)

Assistant: Luke Bibot, PMGO

Setting Up:

Two sites were inspected to set up the variometer equipment, the balloon shed of the National Weather Service, directly opposite the airport terminal and the non directional beacon transmitter hut, which is at the eastern end of the airport grounds. The balloon shed is used to produce hydrogen and hence was unsuitable. The NDB transmitter hut is a secure installation with a 2 metre barbed wire fence and good locks, the site is also remote from traffic. The equipment was set up inside the NDB hut, the cables were taken out the boarded up hole in the wall which once probably housed an air conditioner. There are ample power points in the hut. The heads were placed to the south of the hut. The hut is extremely hot and the NDB transmitter equipment runs continuously every 30 seconds or so. The NDB hut also houses some seismic equipment run by the Port Moresby Geophysical Observatory.

Azimuth Marks: Station D from C, station C from D.

Equipment:

The first few hours of digital X data were lost as a zero signal was being recorded. The problem was found to lie in a faulty BNC T piece connector, this was replaced and data logging

resumed normally. The Elsec E820 did not function at all well, and was switched off for most of the occupation. There was interference on the temperature channel of the Tigraph chart recorder for most of the occupation, possibly from the NDB transmissions. The interference only became apparent when the E820 PPM was switched off. The EDA and other equipment behaved well. A tractor mowed to within one metre of the PPM and EDA heads and cables putting spikes on the magnetic record, but no damage was done.

DIM theodolite 308887 only has numbered graduations on the vertical circle to 20°, the inclination at Kavieng is -20°, so this theodolite will not be usable in the future if the inclination moves closer to zero at Kavieng or at locations closer to the magnetic equator. Also it is impossible to manipulate the theodolite into all the necessary positions with the diagonal eyepiece attached, due to the configuration of the sensor, cable and attached eyepiece. This meant that the steep sighting prism was used for reading the vertical circle, despite the better suitability of the diagonal eyepiece for this job, making observing more difficult and time consuming.

Observations:

Station C was occupied as the primary station. Thirty one DIM observations on C, four on D. Morning and afternoon sunshots on station C. Rounds of angles, local F survey and total field vertical gradient surveys on both stations.

Station Condition and Upgrades:

Both stations are full concrete triangles in good condition. Both were beneath ground level and well covered by thick grass. Station C was located first and the azimuth used to find D. After seeking permission from the DCA foreman both stations were marked with two star droppers to facilitate easier location in the future.

Comments:

It seems to rain almost continuously at this station, chances for sunshots must be taken as they arise.

Noumea B, C

25-29 June 1993 AML

Contacts:
The Director, Department of Geology and Geophysics, ORSTOM, BP A5. Noumea Cedex, New Caledonia (Ph 0011 687 26 10 00, Fax 0015 687 26 43 26, Jacques DANIEL in 1993)
le Directeur de l'Aviation Civile, BP H1 Noumea Cedex, New Caledonia
(the airport manager (commandant) was Guy Francois in 1993)

Assistant: Jean-Louis Laurent, ORSTOM, Roger Decourt, ORSTOM

Setting up:

The equipment was set up in room 50 of the Tontoutel Hotel, as in previous occupations. The sensor heads were set up on the high side of the cutting behind the hotel rooms, between the cutting and the wire fence. This is a good location since it is well away from any interference. Rooms 50, 51 52 and 53 are the best locations for the magnetic equipment and they should be requested at booking or check in. The cables were run out the glass sliding door. This meant that the door could not be

locked, but the wooden shutter external to the door could still be bolted. Power was taken from the room with a power point adapter. The active and neutral pin were reversed compared to the standard Australian plug, this may or may not be a characteristic of French power points, the situation was remedied by reversing active and neutral on a short extension lead. The location is a very convenient one for the equipment since it is only a few minutes drive to the airport.

Azimuth Marks: Station C from station B, station C from station B.

Equipment:

The Elsec E820 variometer PPM would not tune and hence produced very scattered readings, and unusable data. The Doric Trendicator temperature monitor did not produce analogue output, although the display still functioned normally. All the other equipment functioned well.

Observations:

Station B was occupied as the primary station. Thirty two observations on B, four observations on C. Morning and afternoon sunshots on B. Rounds of angles, local F surveys and total field vertical gradient surveys on B and C.

Station Condition and Upgrades:

Both stations were separate plaque and footpads in concrete blocks. The stations were unmarked and almost completely buried. The tape measure was essential in locating the stations. Both stations are an unusual configuration with the plaque at a much lower level (approximately 10 cm) than the footpads. This complicated the upgrading of the stations. Both stations were upgraded to full concrete triangles, although station C in particular is a concave, saucer shaped triangle to allow for the differing levels. The station descriptions were upgraded since the VASIS lights on the original description no longer exist.

Comments:

Access to the airport was through the "Gendarmerie" security gate and a personal pass and vehicle pass is required, once these have been issued no problems were experienced in gaining access to the airport. All the airport authorities, and in particular the airport manager, Guy Francois, were very helpful. A strong wind develops every day after about 11 am local time at the airport, which made observing difficult.

Port Moresby SE, A, B, C

22-27 May 1993 AML

Contacts:

The Officer in Charge Port Moresby Geophysical Observatory, P.O. Box 323 Port Moresby PNG (Mr. Ian Ripper (Ph 0011 675 214500, Fax 0015 675 21 3976)

The Assistant Secretary, Airports, Department of Civil Aviation P.O. Box 684 Boroko PNG (Mr. Noga Itano Ph 24 4400 Fax 292963)

The Safety Officer Airport Maintenance Jackson Airport, Department of Civil Aviation Airports Branch P.O. Box 684 Boroko NCD PNG (Mr. Mellie Wakokon Ph 0011 675 24 4516)

Assistants: Mathew Moihoi, Luke Bibot PMGO

Setting Up:

The variometer and recording equipment was set up at the observatory site at Tabletop. The equipment was placed in the spare room of the seismic vault, the EDA sensor head was set up to the west of the vault and the PPM head to the south. The data cables were run vertically up and out of one of the air vents in the roof of the vault. The fly wire and rain shield on the vent was removed to do this. The spare room is poorly lit and very hot but has ample bench space and power points.

Azimuth Marks:

The "Old Mark" was used from pier SE. The newer "Golf Course Mark" was not visible through the DIM due to the hazy conditions on the first day so the Old Mark was used throughout. The top dead centre of the left hand most distant red and white power pylon was used from station A. The top dead centre of the red and white EM-TV transmitter tower was used from stations B and C.

Equipment:

The equipment ran well throughout the occupation. The variometer E820 PPM produced a spiky but useable record. No temperature trace was recorded on the chart recorder. There were three power failures. Blackouts were very common, almost every afternoon, they usually commence on the hour and last for one hour. Backup batteries in the computer, EDAS and PPM kept those pieces of equipment running. The EDA did not have a backup supply so variometer data was lost.

Observations:

Pier SE of the absolute hut was occupied as the primary station. Twenty four DIM observations on SE, four observations on each of stations A, B and C. Round of angles, local F surveys and F vertical gradient surveys on station A, B and C. Morning and afternoon sunshots on stations A and B.

Station Condition and Upgrades:

Pier SE in the Absolute Hut at the Tabletop observatory site is in good condition. However the whole observatory is in danger of being bulldozed to make way for a new housing development, as described earlier. Stations A, B and C were established. Station A on the observatory grounds at Tabletop, on the top of the hill, in the general location of the proposed new absolute hut. Stations B and C are at Jackson airport, (the Port Moresby International Airport). All three new stations are full concrete triangles enclosing plaque and footpads. All stations were marked with two star pickets. Stations B and C are closer together than the standard configuration because the permitted area was quite small, limited by two roads, a disused power house, a drainage channel and tall grass. One station (C) was aligned with the rear of a large hangar to allow for easy relocation in the future, which meant the other could not be 150 metres distant. The co-ordinates for stations A, B and C were determined with a GPS (Global Positioning System) unit and a barometric altimeter, (calibrated at sea level for station A and a PSM on the airfield of known elevation for stations B and C)

Port Moresby SE, A, B, C, NE

08-11 June 1993 AML

Contacts: as above

Assistants: Mathew Moihoi, Luke Bibot PMGO

Setting Up:

The variometer and recording equipment was set up at the observatory site at Tabletop. The equipment was placed in the spare room of the seismic vault, the EDA sensor head was set up to the west of the vault and the PPM head to the south, as in the previous occupation

Azimuth Marks:

The "Old Mark" was used from pier SE. The top dead centre of the left hand most distant red and white power pylon was used from station A.The top dead centre of the red and white EM-TV transmitter tower was used from stations B and C.

Equipment:

The E820 variometer PPM did not function properly during the occupation, the instrument would only yield low signal strengths and gave very poor (unusable) results. The analogue output from the E820 was not logged on the chart recorder since the spikes obliterated the other good channels. The Tigraph chart recorder malfunctioned on setup and could not be initialized. The problem was later found to be a blown electrolytic capacitor on the power input boards at the back of the unit. This capacitor was replaced and the chart recorder functioned well for the rest of the occupation.

Observations:

Pier SE of the absolute hut was occupied as the primary station. Twenty four DIM observations on SE, six observations on station A and four observations on each of stations B, C and pier NM. (Pier NM is the BMZ pier in the absolute hut. The observations on NM were made to determine a pier difference in Z between SE and NW, there is no mark of known azimuth from pier NM, so no absolute declination observations were made on NM). Morning and afternoon sunshots on station A, overcast weather prevented further sun observations on stations B and C.

Station Condition and Upgrades:

The concrete in stations A, B and C was patched to fill in some small holes due to poor mixing in the initial batch of concrete.

Santa Cruz A, B

14-18 June 1993 AML

Contacts:

The Director, Geological Division, Ministry of Natural Resources. P.O. Box G24 Honiara Solomon Islands

The Provincial Secretary or The Provincial Premier, Temotu Province, Lata, Santa Cruz

Ph (677) 53 063 Fax: 53036 (this is the fax machine in the Telekom Office but it will find the Provincial Secretary or the Premier. Telekom Office Phone 53 118)

Forestry Division, Lata, Solomon Islands MNR. To arrange pick up at the airport with a vehicle.

Assistant: Bobby Kelly, MNR

Setting Up:

The equipment was set up in a spare bedroom of the Provincial Rest House, there is a hole in the fly wire just suitable for the cable to be run out. The heads were set up to the south, in the thick

tropical undergrowth at the foot of the hill on top of which are situated the two town water tanks. The site is near houses and is cut by walking tracks, but there was no magnetic disturbance. Power was taken from the rest house. Initially there was no power at the Rest House but this was rectified by an official from the power house. Power is supplied to the town by diesel generator and is available twenty four hours a day, it was reliable throughout the occupation.

Azimuth Marks: Station B from Station A. Station A from station B

Equipment:

There was no analogue recording during this occupation because the chart recorder was left behind in Honiara to ensure that the other more important equipment would be carried on the flight. The Elsec E820 variometer PPM failed to operate. It was left running but it would not produce consistent signal strengths. Software filtering was used in an attempt to extract some useful F values by limiting the acceptable values to a range of 500 nT but this did not prove successful. The Doric Trendicator would not produce analogue output, hence also no digital output. The Doric display continued to work but the analogue output remained at the same level continuously. This problem could not be rectified. The Doric was left running despite the malfunction. The average temperature during the occupation was approximately 27, with only about 4 degrees between maximum and minimum. Each day of the occupation, between 03:28 and 04:38UT there was a baseline shift on all traces. This was probably due to a generator cutting in or out at the power house.

Observations:

Station A was occupied as the main station. Thirty observations on A and four on B. Morning and afternoon sunshots on A. Rounds of angles, local F surveys and total field vertical gradient surveys on A and B.

Station Condition and Upgrades:

The stations were easily found, they are exposed on the bare coral surface. They are not full triangles, but the coral makes a structure as strong and durable as concrete and it is almost impossible to dig enough away to replace with concrete. The stations are not marked with stakes. The measured distance A to B is 206.6 metres.

Comments:

Lata has been devastated by cyclones in late 1992 and February 1993. The town had not recovered by the time of the occupation. Many dwellings and government buildings had roofs blown off and the rest house was in a very poor state on our arrival. Power was only arranged after we arrived as requested, and the keys to the rest house were located after several hours wait. Things seem to happen quite slowly here. The absolute equipment was left in a lockable room at the back of the airport 'terminal' the key to which was obtained from the SOLAIR agent, Thomas, who met the plane and supervised refueling and unloading. It is important to arrange access to the locker on immediate arrival since there are no vehicles available to take the gear to the airport everyday and it is too far to walk with a heavy load, also the Solair agent may be difficult to locate after the plane has left. The distance from the rest house to the airport is about 1.5 km. It is important to pre-arrange a vehicle to transport the equipment from the airport to the rest house. This can be done through the Geological Division of MNR at Honiara, since the Fisheries division is also part of MNR.

Wewak F, E

04-08 June 1993 AML

Contacts:
The Officer in Charge, Department of Civil Aviation, Wewak Airport, Wewak, East Sepik Province, Papua New Guinea, (Ph 86 2411, Mr. Gabriel Soloway)
The Headmaster, Bishop Leo High School, P.O. Box 178 Wewak, East Sepik Province, PNG (Ph 86 2791)

Assistant: Mathew Moihoi PMGO

Setting Up:

Finding a suitable place to set up the variometer and recording equipment was a major problem in Wewak. Many sites were inspected but deemed to be unsuitable. (The Meteorology balloon filling hut near the airport had no power and no security, the NDB hut has no security for the sensor heads, the VOR installation on the grounds of the airport is too magnetic, The DCA transmitter site, about 12 kilometres away in hills behind Wewak, has very large magnetic gradients, the backyard of a house opposite the airport had too much transient magnetic interference, as did the grounds of the Sepik International Beach Resort). As a last resort the Bishop Leo High School was inspected and found suitable. This site was also used in the 1989 occupation. The headmaster was contacted by phone and gave permission to set up. Fortunately the occupation fell over the weekend, it would not be possible to use the school during weekdays when students were present. The equipment was set up in the library building. The cables were run out a small hole in the floor just in front of the stairs up to the mezzanine floor. There are ample power points available. The heads were placed behind the library building. This proved to be a quiet and secure site, however there were several variometer parameter changes during the occupation, possibly caused by torrential rain shifting the EDA head.

Azimuth Marks: Station E and windsock to east from station F. Station F from E.

Equipment:

The Elsec E820 variometer PPM spiked badly throughout the entire occupation and analogue recording of the PPM was deliberately stopped, so the other traces were not completely overwritten. All other equipment worked well.

Observations:

Station F was occupied as the primary station with twenty six observations on F, eight observations on E, two sets of morning sunshots on F. Wet and overcast conditions prevailed for the whole occupation with only two short periods of sunshine. Rounds of angles, local F surveys and total field vertical gradient surveys were completed on both stations.

Station Condition and Upgrades:

The station D was very difficult to locate. After several hours of scratching around the station plaque mounted in a cylindrical concrete plug was located well below ground level, but no concrete slab or footpads were found. The nearby PSM shown on the station description for D was not located. Footpads and a full concrete triangle were concreted around the existing plaque. Azimuths calculated from sunshots on the newly concreted station to station E were not consistent with data from the previous occupation of station D. Calculated station differences were also inconsistent, so it

seems likely that the newly concreted station was not in the same position as station D at the last occupation. The station is referred to as station F. If the station plaque on D was protruding above ground level it could be possible that grass cutting equipment may have displaced the plaque and concrete plug, however when the plaque was first located it was level, well seated in the ground and appeared to be in the correct position, as best as could be determined from the station description. A detailed description for station F was compiled..

Station E was located easily. It was at ground level and well exposed. Station E is a full concrete triangle. Both stations were marked with a single star picket at the conclusion of the occupation after seeking permission from the airport supervisor.

Future occupations should use station E as the primary and F as the secondary station.

Final Data Reductions

On returning to AGSO all data were checked and reprocessed to derive variometer parameters by adopting a model that assumes the EDA fluxgate variometer measures three components of the magnetic field, not necessarily mutually orthogonal or aligned in any specific way with respect to the geomagnetic or geographic coordinate systems. This was done using the personal computer programs Examine, Reduce, and Compare (Crosthwaite 1994) and a commercial spread sheet package.

The azimuth of the declination reference mark was adopted by checking the sun observations data and comparing calculated azimuths to historical data, where available. A table of all azimuths derived from sun observations made during the survey is presented on page 13. The values shown in Table 5 on page 13 are not necessarily the adopted azimuths. In general if the stations had been previously surveyed by professional surveyors and all other data is consistent, the azimuths obtained by the surveyor have been adopted. Otherwise the best value for azimuth has been adopted, considering available azimuth and angular data. The adopted azimuth values for the primary reference marks and other marks included in the rounds of angles are shown on page 38. The primary reference mark is numbered 1 for each station on pages 38 to 39.

Each absolute observation in the observation data files was checked against the observing forms for typing errors or inconsistencies. HDZ and F baselines were then derived using the field processing programs. All observations were plotted to check for outliers. Average baseline values were then calculated. An HDZF variometer model is assumed at this early stage, with each magnetic element being dependent upon the appropriate variometer channel and independent from all the other variometer channels.

The temperature channel scale value was determined from linear regression of temperature observations against variometer counts and a temperature baseline derived.

The temperature baseline values were averaged and a standard temperature for the occupation adopted by calculating the average temperature at the time of each of the magnetic observations on the primary magnetic station.

The derived variometer baseline values in HDZF were converted to XYZF baselines for inclusion into the programs Reduce and Compare as initial parameters. The other initial variometer parameters were then calculated.

The alignment of the EDA head was initially assumed to be at an angle equal to the calculated average declination baseline as described above, hence an initial three by three scale value matrix was derived using the nominal scale values of the EDAS of 0.2 nT/count and the declination angle, hence the initial set of variometer parameters were:

$$\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} = \begin{pmatrix} B_x \\ B_y \\ B_z \end{pmatrix} + \begin{pmatrix} 0.2 \times \text{Cos } B_d, -0.2 \times \text{Sin } B_d, 0.0 \\ 0.2 \times \text{Sin } B_d, 0.2 \times \text{Cos } B_d, 0.0 \\ 0.0, 0.0, -0.2 \end{pmatrix} \begin{pmatrix} x - x_0 \\ y - y_0 \\ z - z_0 \end{pmatrix}$$

Where X, Y and Z are the magnetic field elements to be calculated from the variometer data, x, y and z the variometer channel counts and x_0 y_0 z_0 the variometer zero recording levels. B_X B_Y B_Z are the baseline values, and B_d is the declination baseline value. Both the baseline drift rate and the temperature coefficients were set to zero for the initial variometer parameter set. (See Crosthwaite, 1991 for a full description of the variometer model.)

These parameters were then refined using a commercially available spreadsheet package by calculating multiple linear regression coefficients of each magnetic absolute element against the three fluxgate variometer channels, temperature and time. Usually two iterations of the regression were adequate. In this way the full scale value matrix, baseline values, baseline drift rates and temperature coefficients were derived which minimize the difference between the observed absolute magnetic values and those calculated from the variometer data using the derived parameters.

For the stations at which the Doric temperature trendicator malfunctioned the temperature coefficients were assumed to be zero. This will not introduce large errors into the derived field values, since ambient temperatures at these tropical stations rarely varied by more than 4 degrees between maximum and minimum and past experience has indicated that the temperature coefficients of the system are generally of the order of 0.5nT per degree.

The final variometer parameters thus derived were then made compatible with the program MAGOBS (Hopgood, 1990) and that program used to first plot the data as a raw ordinate plot, then as daily magnetograms of the elements H, D Z and F (F derived from the other elements). Hourly mean value plots and tables of all elements were also produced with MAGOBS. The hourly mean value plots are used in the adoption of a normal (quiet) field value for each station. Hourly mean value tables for the station occupations are shown commencing on page 46.

Adopted Station Values

The aim of a repeat station occupation is to determine normal (quiet) field values for all the magnetic elements at the station, which in conjunction with results from previous occupations of the station can be used to determine the secular variation of the Earth's magnetic field. It is the normal field values around local midnight on a magnetically quiet night that come closest to representing the long term normal field (McEwin, 1984). However magnetic storms in particular can disturb these night time field values with regard to the long term normal field values for up to several weeks after a severe storm. Hence even on magnetically quiet nights the mean midnight value may need a correction to remove any such storm related disturbances.

This correction was derived by analyzing several months of hourly mean value data from a suitable magnetic observatory, usually one month prior to the month of occupation, the month of occupation and one month after the occupation. A suitable observatory is often, but not always, the closest observatory to the magnetic repeat station. The normal field level for the observatory was adopted with reference to periods of undisturbed (i.e. no magnetic storms) record and the quietness of the night time record around local midnight. This level was then transferred to the station record by comparing the morphology of both records, which enable an equivalent normal field level to be adopted for the repeat station. A corrected normal station value was then determined for all elements.

Hourly mean value data digitized from the analogue daily magnetograms from the Port Moresby Magnetic Observatory and digital data from the Charters Towers Observatory were used to correct all stations in the survey, except for Noumea, where digital data only from the Charters Towers Observatory was used.

The adopted normal field values at the epoch of occupation are shown below in Table 7. Secular variation rates at the epoch of occupation are shown in Table 8.

Table 7. Adopted normal field values at epoch of occupation

Station	Occupat'n Date	D (° ′)	H (nT)	F (nT)	Z (nT)	X (nT)	Y (nT)	I (° ′)
Honiara B	21-Jun-93	09 35.3	35532	41203	-20861	35036	5918	-30 25.0
Kavieng C	30-May-93	06 24.5	36540	39078	-13854	36312	4078	-20 45.8
Noumea B	27-Jun-93	12 55.5	32267	48323	-35972	31449	7217	-48 06.5
Port Moresby SE	24-May-93	06 35.3	35944	43023	-23644	35707	4124	-33 20.2
Port Moresby SE	10-Jun-93	06 35.5	35945	43023	-23641	35707	4126	-33 20.0
Santa Cruz A	16-Jun-93	10 13.9	35280	41214	-21305	34719	6267	-31 07.6
Wewak E	05-Jun-93	04 52.4	37056	40507	-16363	36922	3148	-23 49.3

Table 8. Secular variation at epoch of occupation

Station	dD (′/yr)	dH (nT/yr)	dF (nT/yr)	dZ (nT/yr)	dX (nT/yr)	dY (nT/yr)	dI (′/yr)
Honiara B	-0.7	4.3	-14.9	33.0	5.4	-6.0	-2.6
Kavieng C	-0.6	8.9	-0.6	28.0	9.6	-5.3	-2.6
Noumea B	-0.6	-9.0	-25.0	29.8	-7.5	-7.7	-0.9
Port Moresby SE	-0.2	7.9	-6.0	32.4	8.1	-1.3	-2.5
Santa Cruz A	-1.1	-0.3	-19.1	35.0	1.7	-11.2	-2.5
Wewak E	-0.8	-0.6	-12.9	25.7	0.1	-8.3	-2.0

Recommendations

Logistics

- An assistant is helpful at all stations and should be organised wherever possible, and in particular it is important to be met at Tontouta Airport by a French speaking person to assist with customs formalities. A good knowledge of French would be very useful for the occupation of Noumea. A full time assistant at Santa Cruz is also very desirable, since much walking and carrying is necessary. A second full time AGSO officer on the survey would bring the work load to a more acceptable level.
- To ensure trouble free entry of the equipment into Noumea a Carnet ATA should be arranged for the equipment before leaving on survey. A comprehensive list of all equipment, serial numbers and approximate dollar value is also an essential document.
- Most food should be taken to Santa Cruz and adequate time should be allowed in Honiara for shopping and re-packing.
- All flights, accommodation and hire cars should be pre-booked well in advance. Reconfirmation, especially of hire cars in PNG, is essential and should be done as often as possible.
- Every chance should be taken to pre-warn airlines of the large amount of excess baggage. Written personal assurances from public relations, port or traffic managers that the equipment

will be carried on the same flight are most useful. It is a good policy to watch all the equipment as it is loaded aboard the aircraft to ensure that none is left behind. At no stage was an extra seat booked for the equipment, but on some smaller aircraft this may be an option to ensure the equipment is carried. All flights within PNG were on large F28 aircraft. The only small aircraft used on the survey was from Honiara to Santa Cruz and return.

Equipment

- Most of the equipment operated well, however there is a need to upgrade the chart recorder, since the Tigraph is a heavy instrument which is very awkward to pack and not fully reliable. A smaller six channel colour pen or print recorder would be better suited to the requirements of the survey.
- The E820 variometer PPM had a very poor operating record on the survey. A more robust base station PPM would be desirable.
- At several locations a longer cable between the EDA electronics unit and the EDA head would have been very useful. The current cable is 30 metres long, a 50 metre cable would be better.
- A more secure and stable method of securing the EDA sensor head is desirable. The current method of mounting the head on a long spike still allows baseline drifts to occur, possibly due to slight rotations of the head (and spike) in the ground, particularly if the ground is wet at the time of mounting the head or heavy rain falls during the occupation.
- A hand held GPS receiver would be useful to check the latitude and longitude of existing and newly installed stations.
- Finding a suitable location for the variometer and recording equipment was a major problem at some stations. A small waterproof tent would have been useful at Honiara and possibly Wewak. A suitable tent should be carried with the survey or sent to the Geological Division in Honiara before leaving on survey.
- A backup power system would be desirable at most locations, however the weight of batteries and other equipment makes it difficult to organise and extremely expensive to transport.

Conclusions

Geomagnetic secular variation and field strength data were collected from six magnetic repeat stations throughout the south west Pacific region to first order standard. Three new remote reference stations were installed for the Port Moresby Observatory. Three existing stations (Noumea B, C and Wewak E) were upgraded to full concrete triangles enclosing plaque and footpads.

Acknowledgments

The assistance of the many national agencies involved in the survey is gratefully acknowledged; Mr. Ian Ripper and all staff of the Port Moresby Geophysical Observatory, in particular Mathew Moihoi and Luke Bibot; the Director and staff of the seismology section of the Ministry of Natural Resources, Solomon Islands and in particular Mr. Bobby Kelly who assisted at Santa Cruz and Honiara; the Director of the Department of Geology and Geophysics, ORSTOM, New Caledonia, and in particular Jean-Louis Laurent and Roger Decourt from ORSTOM.

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Appendices

Contact Addresses

Contacts within Australia:

The Assistant Secretary South Pacific Branch Department of Foreign Affairs and Trade Administration Building Parkes, ACT 2600 (David O'Leary)	The Officer in Charge Australian Customs Service ACT Sub Collectorate GPO Box 148 Fyshwick ACT Ph 280 6999 Fax 280 7128 (Roger Lane)

Contacts within Papua New Guinea.

General Contacts and Port Moresby:

The Observer in Charge. Port Moresby Geophysical Observatory, P.O. Box 323 Port Moresby Papua New Guinea. Ph 0011 675 21 4500 fax 0015 675 21 3976 (Mr. Ian Ripper)	The Chief Government Geologist Department of Minerals and Energy P.O. Box 778 Konedobu National Capital District Papua New Guinea (L. Palaso)
The Secretary Department of Minerals and Energy P.O. Box 352 Konedobu National Capital District Papua New Guinea	The Assistant Collector (Revenue) Bureau of Customs and Excise P.O. Box 1830 Port Moresby Papua New Guinea Ph 0011 675 21 1172/212536 Fax 0015 675 21 2892
The Assistant Secretary, Aerodromes Department of Civil Aviation P.O. Box 984 Boroko N.C.D. Papua New Guinea Ph 0011 675 24 4400 Fax 0015 675 29 2963 (Mr. Noga Itana)	The Public Relations Manager Air Nuigini P.O. Box 7186 Boroko Papua New Guinea Ph 27 3415 Fax 27 3416 (Mr. G. McLaughlan)

Kavieng

The Officer in Charge Department of Civil Aviation P.O. Box 53 Kavieng New Ireland Papua New Guinea Ph 0011 675 94 2075 (Andrew Nemar)	The Port Manager, Kavieng Air Nuigini P.O. Box 63 Kavieng New Ireland Papua New Guinea Ph 0011 675 94 2233 (Jack Cameron)

Wewak

The Officer in Charge Department of Civil Aviation Wewak Airport Wewak ESP Papua New Guinea (Gabriel Soloway)	The Head Master The Bishop Leo High School P.O. Box 178 Wewak E.S.P. Papua New Guinea Ph 0011 675 86 2791
The Port Manager Air Nuigini P.O. Box 61 Wewak, E.S.P. Papua New Guinea Ph 0011 675 86 2367 (Freddy Neisause)	

Contacts within the Solomon Islands.

General Contacts and Honiara.	
The Director Geological Division Ministry of Natural Resources, P.O. Box G24 Honiara, Solomon Islands. Ph. 0011 677 21521 Fax 0015 677 21 245 (Mr. Don Tolia)	The Principle Aviation Officer Civil Aviation Ministry of Aviation and Tourism P.O. Box G20 Honiara Solomon Islands Ph 0011 677 30567 Fax 0015 677 30775

The Comptroller of Customs Customs and Excise HQ P.O. Box 201 Honiara Solomon Islands.	The High Commissioner Australian High Commission Honiara Solomon Islands Ph 0011 677 21 561 Fax 0015 677 23 692

Santa Cruz

The Provincial Premier
Temotu Province
Lata Station
Santa Cruz Islands
Solomon Islands
Ph 0011 677 53 063
Fax 0015 677 53 036 (Lata Telekom, this will get to the Premier)

Contacts within New Caledonia

The Director Department of Geology and Geophysics ORSTOM BP A5 Noumea-Cedex New Caledonia Ph 0011 687 26 10 00 Fax 0015 687 26 43 26 (Jacques Daniel)	The Director l'Aviation Civile BP H1 Noumea-Cedex New Caledonia
Le Directeur Regional Service des Douanes Noumea-Cedex New Caledonia	Consul General of Australia BP 22 Noumea-Cedex New Caledonia Ph 0011 687 27 24 14 Fax 0015 867 27 80 01 (Leslie Rowe)

Hotels and Hire Cars

Honiara

The Airport Motel
P.O. Box 251
Honiara
Solomon Islands
Ph 0011 677 30 446
Fax 0015 677 30 411

A small but good quality motel in a quiet location, easy walking distance to the airport, but about 15 kilometres out from Honiara. Rooms are large and well lit, with refrigerator, telephone and air

conditioner. There is a fax machine available at the desk. The motel restaurant is good, but is the only place to get food apart from Honiara and a small shop in the terminal which is only occasionally open. Tariff $SBD100 per night. The motel does accept Mastercard.
Hire Cars, from Avis rent-a car.

A Mazda twin cab utility collected and returned to the Avis desk at the airport. Tariff $SBD250 per day. Avis gave very good service, the car was waiting, even though it could not be confirmed from Santa Cruz. Avis do accept Mastercard.
Ph 0011 677 23 205

Noumea

The Tontoutel Hotel
BP 8
Tontouta
New Caledonia
Ph 0011 687 35 11 11

Very convenient to the airport and the only hotel in the area, since Noumea itself is over 50 kilometres from the airport. The rooms are small and poorly lit. Has a television, telephone and air conditioner. The restaurant is good but quite expensive, there are some other places to eat a few kilometres away. Tariff 5200 CFP per night. Mastercard was accepted by the hotel.
Hire Car from MenCar.

A Peugot 405 station wagon was organised from Mencar. There was difficulty in collected the vehicle upon arrival since there was a long delay in talking to the customs service and the Mencar representative took the car back to Noumea without waiting. The vehicle was then collected from the Mencar office in Noumea late on the afternoon of the same day, a round trip of over 100 kilometres and very inconvenient. I would recommend a car be organised with one of the better known hire companies (Avis, Budget or Hertz) for subsequent occupations, all the major companies have desks at the airport. The car was left at the airport upon departure. Tariff 9400 CFP per day. Mencar accepted Mastercard. (Ph 0011 687 27 61 25 Fax 0015 687 28 17 59)

Port Moresby

The West Side Motel
Spring Garden Road
Konedobu
Port Moresby
Papua New Guinea
Ph 0011 675 21 7057
Fax 0015 675 21 4739

An average quality motel. Very convenient to the observatory office and the Port Moresby business district. The rooms are nearly all upstairs, which can be inconvenient for carrying equipment, rooms are air-conditioned and have a TV and refrigerator (if you chase them up), but no phone, the pay phone in the entrance foyer rarely works. There is not a lot of desk space or power points for data processing and the lighting is only just adequate for night work, best to borrow a desk lamp from the observatory office. Only occasional warm water for showers. On street vehicle parking with all night security guard. A post office and small supermarket are within 2 minutes walk from the hotel. Tariff 54 Kina. The hotel does accept Mastercard
Hire Car, from Budget Rent a Car.

A Mitsubishi L200 Twin cab 4WD Utility from Budget, at the Gateway Hotel, very close to airport. Budget also have an office at the airport. A 4WD is necessary to climb the steep hill to station A at the observatory. Tariff 77 Kina per day + 67 toea per kilometre traveled. Budget do accept Mastercard and gave a 10 % discount to the Australian Government.

Kavieng
The Kavieng Hotel
P.O. Box 4
Kavieng, New Ireland
PNG
Ph 0011 675 94 2199

A very nice motel, large, clean and well lit rooms with plenty of bench space. Rooms are air-conditioned and have a ceiling fan, telephone refrigerator and television. The hotel has a swimming pool, access to a golf course and an excellent restaurant. The hotel is about 2 kilometres from the airport, on the main road through town. Tariff 85 kina. This is the only hotel in town, however there is a good quality, newly constructed lodge on the sea front which also provides accommodation. The Kavieng Hotel accepted Mastercard.
Hire Car from the Kavieng Hotel.

Toyota Hilux Twin Cab Ute. The vehicle was in very poor condition, and the booking was poorly organized. The car was not available upon arrival and did not arrive for over 24 hours, fortunately the manager made his Mazda Twin cab available for the interim period. Tariff 120 kina per day + 25 kina for a tank of petrol. There do not appear to be any other hire car outlets available. If there are other hire cars companies by the time of the next occupation they will almost certainly provide better service at a cheaper rate.

Comments: Kavieng is quite a large town with a Westpac Bank, a good Hardware store, petrol station, several supermarkets and general stores, all within easy walking distance from the hotel. There has been a new airport terminal building constructed in traditional local style architecture since the previous occupation in 1989. There is a small kiosk, pay phone, souvenir shop and the Air Nuigini office in the new terminal building.

Wewak
The Sepik International Beach Resort
Wewak, East Sepik Province, PNG
Ph 0011 675 86 2388
Tribal World Hotels
P.O. Box 86 Mt. Hagen
Western Highlands Province
Papua New Guinea.

The hotel is the closest accommodation to the airport, about 5 kilometres distant, and on the main road to Wewak from the airport The Bishop Leo High School is only 2 kilometres away. The rooms are small, but have an air conditioner, telephone, television and refrigerator. The lighting is extremely poor and there is very little desk space for data processing. There is very tight security with a guard and locked gate at the carpark entrance, and 24 hour security guards with dogs on the hotel grounds at night. The carpark is quite a distance from most of the rooms, specially when several trips with heavy equipment have to be made. Tariff 135 kina per night. Mastercard was accepted.
Hire Car from Avis, Wewak.

A Mazda two wheel drive single cab ute. Picked up and dropped off at the Avis office at the airport. The car was in good condition, but the cab was a little small to be comfortable. Again the pre-booking seemed to be ignored and the car was only organised over the phone on the day before the occupation was to commence. (Ph 86 2041) Tariff 94 kina per day. Avis accepted Mastercard. Hertz is the only other hire car company in town.

Comments: Wewak is a large town with Westpac and ANZ banks, a good hardware store and many other shops and markets. There is another hotel in town, the Sepik Hotel. This is further from the airport, but closer to town. It looked fairly run down in 1993.

Santa Cruz
The Provincial Rest House
Lata
Temotu Province
Santa Cruz
Solomon Islands
Ph 0011 677 53 063
Fax 0015 677 53 036 (this is the fax machine in the Telekom office)

The rest house is the only accommodation available at Lata. Bookings are made through the Provincial Government. (The Provincial Secretary (the PS) is the best person to contact). The rest house is about one kilometre from the airport. The Rest House is very basic accommodation. It has a refrigerator, gas stove, electricity and occasional running water. There was no power on our arrival and this had to be followed up with the PS, there was also no gas and no usable cooking or eating utensils (can opener), these were obtained on loan from the nearby residence occupied by the PS and his family. There are some mattresses but no linen, towels or toilet paper. Insect repellent and a mosquito net are essentials. Tariff 20 Solomon Island Dollars per night per person. Mastercard is not acceptable.

There are no hire cars available at Lata. It is important to pre-arrange the Provincial Government vehicle or the Fisheries Division vehicle to transport the equipment from the airport to the rest house and back again at the start and finish of the occupation, at all other times walking is the only means of transport. It is important to get the use of the lockable cubicle at the back of the terminal building to store equipment overnight so the absolute instruments etc. do not have to be carried up to the rest house every night. It is best to arrange this with the SolAir agent and get the key to the cubicle immediately on arrival at Lata, since he will be difficult to find afterwards. It is also important to pay excess baggage for the return trip at Honiara since no credit cards are accepted at Lata.

Comments:

There is very little available at Lata; there are two general stores which carry a limited range of tinned food, softdrinks, alcohol and other general items, but most food required for the occupation should be brought from Honiara if possible. Phone calls can be made from the Telekom office, but there are no public phones as such. There is a small agency for Westpac and the ANZ bank, although I would not be confident that they would change travellers cheques. All money should be taken as cash from Honiara. Credit cards were not accepted in 1993. The flight Honiara to Santa Cruz was made on a Twin Otter, the smallest plane travelled in during the survey. Capacity is limited so the absolute minimum amount of equipment should be taken to ensure that it all gets on the flight. The chart recorder and other unnecessary equipment should be left in Honiara. It is very desirable to take an assistant from the MNR in Honiara to Santa Cruz to assist in the survey.

Port Vila
The Windsor Hotel International
Kumul Highway
(P.O. Box 810)
Port Vila
Vanuatu
Ph 0011 678 22 150
Fax 0015 678 22 678

Port Vila was not a station re-occupation but a one day stop over in order to get to Noumea from Honiara. The Windsor Hotel is a good quality hotel with large well lit self contained rooms, including all cooking and eating facilities and telephone. There is a good restaurant and a gaming room at the front of the hotel. The hotel is within walking distance to the main shopping centre of Pt Vila and approximately seven kilometres from the airport. Tariff 15000 Vatu. The hotel accepted Mastercard. Pt Vila is bilingual, has left hand drive cars but Australian style power points.

Equipment and Packing

Location	Serial Number	BMR Barcode
Aluminium Box 1 (Recording Equipment)		
12 V plug pack power supply		
cables, leads and connectors		
Digital Clock		
Doric Thermograph	308019	0015257
Double adapter		
EDA FM-100B console		0015247
Edas-2	091	0015258
Elsec E820 PPM console	128	0015256
Elsec E820 PPM console	158	0014822
Fluke 77 Digital Multimeter	42600006	0011404
power extension leads (2) short		
Sangean Radio receiver		
Aluminium Box 2 (Absolute Box)		
Brass tripod foot pipes		
DIM theodolite Zeiss-Jena 020B	308887	0011413
Electronic Stop watch (Micronta)		
Elsec E770 Console	211	0018816
Elsec E770 console	214	0018815
Elsec E770 Sensor head and cable	211	
Elsec E770 Sensor head and cable	214	
Elsec E810 console	213	0014730
Elsec E810 console	220	0011412
Stand for E770 head		
Aluminium Box 3 (Computer Box)		
Computer, Toshiba 3100SX laptop	12912705	0011304

DIM Theodolite Zeiss-Jena 020B	311542	0014729
EDAS-2 (spare)	066	0015270
Penciling board, spare		
Power supply, Toshiba	A9000678S	

Aluminium Box 4 (Cable Box)

EDA sensor head		0002329
Power spike filter/distribution board	92356	
PPM cable		
Texas Instruments Tigraph 100 chart recorder	0101001711	0015249

Aluminium Box 5 (Spares)

18V power supply
Adapter for E820 head + three piece pole
Assorted ropes
Brass station Markers (6)
Canon F-73 electronic calculator
Chart paper (3 rolls)
EDA boards, spare
Electronic Stop watch (Micronta spare)
Elsec E820 sensor head + cable 139
Equipment Handbooks
Flagging Tape
Garbage bags
Hacksaw
Leads and connectors, spare
Masking tape
Mounting pole for E820 PPM
Observation forms
Octopus straps
Packing tape
Plastic tool box
Reports
Roll of wire
Spike for EDA head (short, spare)
Stationery (pens, pencils, rubber bands, log book, note books)
steel tape measure, 2m
Three pin power point adapters (for Noumea) (2)
Torch + battery
Trowel

Red 44 litre Esky 0011407

Butane soldering iron kit
Cable for EDA sensor head
Computer disk drive cleaning kit
Computer diskettes

Electronic spares box (fuses, clips, sockets, tape etc.)
Electronics cleaning spray
Hammer
Jewelers Screwdrivers set
Magnetic compass
Tape measure, 60m (2)
Tent fly (for EDA) + poles, ropes and 8 stainless steel pegs
Tool roll

Small Tripod Bag.
aluminium pole (azimuth mark)
Power extension lead (long)
Spirit Level
yellow DIM tripod (1)

Large Tripod Bag
Observing shelter poles
observing shelter tent fly
Spare tent fly and guy ropes
stainless steel tent pegs (8)
Three lengths of Aluminium
Wooden Pole for PPM
yellow DIM tripod

Hand Luggage

Computer, Toshiba 3100SX laptop	12912724	0002321
Keypad, Toshiba	012804	
Power supply, Toshiba	K8902418S	

Reference Marks and Azimuths

All azimuths are listed in degrees, minutes and seconds from true north. The azimuth mark labeled 1 at each station was used as the primary azimuth mark for that station. Abbreviations used in the table are explained at the end of this section.

	°	′	″
NOU B Noumea B			
1 station C	241	26	03
2 LH edge, top white box on glide angle tower	116	16	53
3 TDC LH aerial behind Navy hangar	138	07	23
4 BDC windsock near station C	246	24	18
NOU C Noumea C			
1 Station B	061	26	03
2 LH edge, top white box on glide angle tower	087	44	39
3 LH base of RH light tower infront of terminal	110	06	52
4 TDC RH aerial above Navy Base	132	32	38
5 TDC RH red and white aerial on hill	162	19	11
HON B Honiara B			
1 Station C	303	03	04
2 Spike on top of RH radio mast	129	54	54
3 Spike on top of LH radio mast	124	23	40
4 TDC RH Pyramid (NDB) tower	041	30	23
5 RH edge rail, RH top of 'Henderson Tower'	277	24	03
HON C Honiara C			
1 Station B	123	03	04
2 Spike on top of RH radio mast	128	52	19
3 Spike on top of LH radio mast	124	11	05
4 2'nd aerial from left, on control tower	045	09	08
5 RH edge rail RH top of 'Henderson Tower'	265	46	04
SCZ A Santa Cruz A			
1 Station B	074	36	33
2 Crack before "S" in terminal sign	161	33	20
3 Windsock to west at horizon level	247	57	21
SCZ B Santa Cruz B			
1 Station A	254	36	33
2 Nearest corner on terminal building	222	17	42
3 Windsock at level of horizon	249	44	10
KAV C Kavieng C			
1 Station D	354	53	02
2 Windsock to northwest, bolt at base	331	24	43
3 Windsock to southeast	125	59	22
4 Front, furthest (Arrivals) wooden gable new terminal	144	20	23
KAV D Kavieng D			
1 Station C	174	53	02
2 Windsock to west, bolt at base	313	08	12
3 Vertical part of centre upright, satellite dish tower	279	01	43
4 Front of Arrivals wooden gable on the new terminal	160	28	00
5 Windsock to south east	137	20	34

WEW F Wewak F	
1 Station E	271 21 46
2 BDC windsock to the east	109 35 59
3 T LH side tallest aerial to NE	074 56 49
4 LH edge, terminal building	005 57 37
5 BDC windsock to NW	295 12 18
WEW E Wewak E	
1 Station F	091 21 46
2 BDC windsock to east	106 00 55
3 LH top of tallest aerial to NE	077 29 12
4 LH side terminal roof	029 04 25
5 BDC windsock to NW	302 53 53
PMG S Port Moresby Observatory Pier SE	
1 Old Declination Mark	340 43 55
2 Golf Club Mark (new Mark)	108 40 19
PMG A Port Moresby Observatory station A	
1 TDC LH distant power pylon to east	102 11 13
2 Golf Club Mark (new mark)	106 42 12
3 LH side of concrete water tank	142 02 08
4 TDC Red and White communications tower to south	173 17 28
5 LH bottom of LH support on MOBIL sign	019 00 30
PMG B Jackson Airport (Port Moresby) B	
1 TDC of the EM-TV transmitter tower (red and white)	244 16 42
2 Station C	225 04 18
3 TDC of the NBC radio Tx tower	199 35 01
4 TDC red and white aerial atop control tower	189 54 53
5 RH edge of power house	163 05 49
PMG C Jackson Airport (Port Moresby) C	
1 TDC of the EM-TV transmitter tower (red and white)	244 26 03
2 TDC of the NBC radio Tx tower	199 09 16
3 TDC red and white aerial atop control tower	188 47 58
4 Nearest corner of power house	132 48 35
5 station B	045 04 18

Abbreviations:

LH Left hand
NBC National Broadcasting Commission
NDB Non Directional Beacon
RH Right hand
TDC Top dead centre
Tx Transmitter

Magnetic Observations

The observations shown in this appendix are those measured with the primary Declination -Inclination Magnetometer and proton precession magnetometer. The observations have had instrument corrections applied.

Units are in nanoTesla for F, degrees and decimal minutes for D and I and Celsius for temperature. Times are the average time for one observation comprising individual F D I F readings and are recorded in UT as hour, minute and second (HH:MM:SS).

Honiara (20-22/June/1993 AML)

YEAR	SITE	STN	DAY	TIME	F	I	D	T
1993	HON	B	171	04:44:18	41204.3	-030 24.4	009 36.6	
1993	HON	B	171	04:56:15	41202.4	-030 24.5	009 36.6	
1993	HON	B	171	05:06:02	41201.9	-030 24.6	009 36.6	
1993	HON	B	171	05:54:53	41192.4	-030 25.2	009 36.6	
1993	HON	B	171	22:21:25	41209.4	-030 24.8	009 35.9	
1993	HON	B	171	22:36:28	41209.5	-030 24.7	009 35.1	
1993	HON	B	171	22:50:44	41208.9	-030 24.8	009 34.7	
1993	HON	B	171	23:00:02	41209.9	-030 24.8	009 34.5	
1993	HON	C	172	01:19:48	41235.8	-030 18.4	009 29.1	
1993	HON	C	172	01:36:14	41236.2	-030 18.4	009 29.0	
1993	HON	C	172	01:43:54	41236.6	-030 18.3	009 28.8	
1993	HON	C	172	01:59:26	41235.8	-030 18.3	009 28.7	
1993	HON	B	172	04:55:02	41207.4	-030 24.3	009 35.4	
1993	HON	B	172	05:07:28	41206.6	-030 24.5	009 35.6	
1993	HON	B	172	05:20:21	41205.4	-030 24.5	009 36.1	
1993	HON	B	172	05:29:22	41204.5	-030 24.6	009 36.2	
1993			172	21:13:00				24.51
1993	HON	B	172	22:38:24	41227.3	-030 23.5	009 35.2	
1993	HON	B	172	22:48:55	41226.9	-030 23.3	009 34.9	
1993			173	01:48:00				27.83
1993			173	03:04:00				28.28
1993	HON	B	173	03:50:53	41228.4	-030 22.5	009 34.2	
1993	HON	B	173	03:59:48	41225.9	-030 22.5	009 34.5	
1993	HON	B	173	04:42:02	41218.0	-030 22.9	009 35.4	
1993	HON	B	173	04:51:19	41216.1	-030 23.1	009 35.4	
1993	HON	B	173	05:01:20	41214.3	-030 23.3	009 35.6	
1993	HON	B	173	05:11:26	41212.9	-030 23.6	009 35.7	
1993			173	05:56:00				27.02
1993	HON	B	173	21:13:04	41214.9	-030 24.2	009 36.7	
1993	HON	B	173	21:22:51	41215.6	-030 24.2	009 36.6	
1993	HON	B	173	21:32:23	41215.0	-030 24.2	009 36.7	
1993	HON	B	173	21:41:46	41213.9	-030 24.1	009 36.4	
1993			173	22:39:00				24.57

Kavieng (28/May - 01/June/1993 AML)

YEAR	SITE	STN	DAY	TIME	F	I	D	T
1993			148	04:01:60				31.43
1993	KAV	C	148	04:30:49	39046.3	-020 45.5	006 24.3	
1993	KAV	C	148	04:50:33	39048.8	-020 46.0	006 24.9	
1993	KAV	C	148	05:04:19	39051.8	-020 46.0	006 25.2	
1993	KAV	C	148	05:13:10	39052.0	-020 46.0	006 25.2	
1993			148	05:45:00				31.57
1993	KAV	C	148	06:08:34	39053.8	-020 46.3	006 25.5	
1993	KAV	C	148	06:17:26	39055.3	-020 46.5	006 25.8	
1993			148	22:21:00				28.12
1993	KAV	C	148	23:08:27	39080.4	-020 47.0	006 23.1	
1993	KAV	C	148	23:19:13	39077.1	-020 46.9	006 23.0	
1993	KAV	C	148	23:28:15	39075.6	-020 46.7	006 22.9	
1993	KAV	C	148	23:37:20	39072.8	-020 46.6	006 23.1	
1993	KAV	D	149	00:25:51	39087.4	-020 47.0	006 24.9	
1993	KAV	D	149	00:40:33	39083.0	-020 46.9	006 24.7	
1993	KAV	D	149	00:46:33	39081.8	-020 46.7	006 24.6	

1993	KAV	D	149	01:02:18	39078.8	-020 46.5	006 24.6	
1993			149	01:43:00				28.80
1993			149	05:52:00				29.69
1993	KAV	C	149	06:49:25	39050.6	-020 45.9	006 25.8	
1993			149	07:11:00				29.71
1993			149	22:54:00				26.66
1993	KAV	C	149	23:34:14	39090.8	-020 46.7	006 23.3	
1993	KAV	C	149	23:44:40	39093.3	-020 46.7	006 23.5	
1993	KAV	C	149	23:55:21	39094.2	-020 46.7	006 23.3	
1993	KAV	C	150	00:03:57	39094.8	-020 46.6	006 23.2	
1993			150	00:40:00				28.03
1993			150	05:44:00				27.14
1993			150	06:48:00				27.48
1993	KAV	C	150	06:05:46	39059.6	-020 45.5	006 26.0	
1993	KAV	C	150	06:14:11	39059.6	-020 45.5	006 25.9	
1993	KAV	C	150	06:21:49	39061.0	-020 45.6	006 26.0	
1993	KAV	C	150	06:29:19	39060.6	-020 45.7	006 25.9	
1993			150	22:11:00				28.25
1993	KAV	C	150	23:06:58	39089.5	-020 46.2	006 24.0	
1993	KAV	C	150	23:17:19	39090.4	-020 46.0	006 24.0	
1993	KAV	C	150	23:25:00	39088.7	-020 45.9	006 23.9	
1993	KAV	C	150	23:32:22	39088.9	-020 45.9	006 23.9	
1993			151	01:16:00				31.93
1993			151	04:15:00				33.29
1993	KAV	C	151	06:21:58	39074.3	-020 45.6	006 26.4	
1993	KAV	C	151	06:30:25	39073.6	-020 45.6	006 26.4	
1993	KAV	C	151	06:36:51	39072.3	-020 45.7	006 26.3	
1993	KAV	C	151	06:44:26	39074.5	-020 45.7	006 26.2	
1993			151	07:04:00				32.05
1993			151	22:03:00				28.55
1993	KAV	C	151	22:31:19	39088.1	-020 46.4	006 23.8	
1993	KAV	C	151	22:40:19	39090.5	-020 46.4	006 23.5	
1993	KAV	C	151	22:48:25	39089.7	-020 46.4	006 23.3	
1993	KAV	C	151	22:56:35	39090.0	-020 46.4	006 23.4	
1993			151	00:00:02				29.56

Noumea (25-29/June/1993 AML)

YEAR	SITE	STN	DAY	TIME	F	I	D	T
1993			176	07:09:00				21.68
1993			176	20:44:00				17.67
1993	NOU	B	176	22:43:32	48314.4	-048 05.0	012 55.5	
1993	NOU	B	176	22:55:55	48314.1	-048 04.9	012 55.4	
1993	NOU	B	176	23:07:48	48313.3	-048 04.7	012 54.9	
1993	NOU	B	176	23:19:19	48312.4	-048 04.8	012 54.8	
1993			177	01:27:00				25.12
1993			177	02:16:00				25.50
1993	NOU	B	177	03:03:44	48300.9	-048 05.0	012 57.2	
1993	NOU	B	177	03:15:57	48300.5	-048 04.9	012 57.6	
1993	NOU	B	177	03:26:54	48301.1	-048 05.0	012 58.2	
1993	NOU	B	177	03:40:08	48299.6	-048 05.1	012 59.0	
1993	NOU	B	177	05:03:37	48296.0	-048 05.4	012 58.5	
1993	NOU	B	177	05:13:14	48295.8	-048 05.5	012 59.0	
1993	NOU	B	177	05:22:52	48297.4	-048 05.5	012 58.6	
1993	NOU	B	177	05:31:48	48297.5	-048 05.4	012 58.6	
1993			177	05:56:00				23.70
1993			177	20:43:00				17.05
1993			177	20:50:00				17.28
1993	NOU	B	177	21:37:36	48322.1	-048 05.0	012 56.9	
1993	NOU	B	177	21:48:26	48323.2	-048 04.9	012 56.8	
1993	NOU	B	177	21:58:20	48322.8	-048 04.9	012 56.8	
1993	NOU	B	177	22:08:59	48322.8	-048 04.9	012 56.7	
1993	NOU	C	177	23:35:14	48256.8	-048 05.3	012 52.1	
1993	NOU	C	177	23:52:18	48256.8	-048 05.2	012 52.1	
1993	NOU	C	177	23:59:17	48256.3	-048 05.2	012 52.0	
1993	NOU	C	178	00:15:26	48257.3	-048 05.2	012 51.9	

1993			178	01:49:00				25.38
1993			178	01:59:00				25.48
1993	NOU	B	178	04:52:24	48303.7	-048 05.1	012 58.8	
1993	NOU	B	178	05:04:47	48303.4	-048 05.0	012 58.8	
1993	NOU	B	178	05:13:45	48302.8	-048 05.1	012 58.6	
1993	NOU	B	178	05:22:52	48302.8	-048 05.0	012 58.6	
1993			178	07:44:00				19.69
1993			178	20:41:00				16.79
1993	NOU	B	178	21:26:21	48319.0	-048 04.1	012 57.0	
1993	NOU	B	178	21:38:53	48320.2	-048 04.1	012 56.6	
1993	NOU	B	178	21:48:21	48321.2	-048 04.2	012 56.6	
1993	NOU	B	178	21:57:55	48320.4	-048 04.2	012 56.4	
1993			179	00:41:00				21.38
1993			179	01:58:00				21.87
1993			179	04:08:00				22.53
1993	NOU	B	179	04:57:23	48307.7	-048 04.7	012 57.9	
1993	NOU	B	179	05:06:52	48307.9	-048 04.7	012 58.0	
1993	NOU	B	179	05:16:15	48309.1	-048 04.8	012 58.1	
1993	NOU	B	179	05:25:51	48309.4	-048 04.8	012 58.0	
1993			179	08:25:00				19.06
1993	NOU	B	179	22:02:24	48330.3	-048 04.0	012 56.2	
1993	NOU	B	179	22:14:15	48330.2	-048 04.1	012 56.1	
1993	NOU	B	179	22:22:53	48330.8	-048 04.0	012 55.9	
1993	NOU	B	179	22:32:17	48330.6	-048 04.1	012 55.8	

Port Moresby (22-26/May/1993 AML)

YEAR	SITE	STN	DAY	TIME	F	I	D	T
1993			142	00:51:60				32.47
1993	PMG	SE	142	01:37:28	43022.1	-033 18.5	006 33.6	
1993	PMG	SE	142	01:54:58	43021.3	-033 18.3	006 34.1	
1993	PMG	SE	142	02:08:30	43021.6	-033 18.3	006 33.7	
1993	PMG	SE	142	02:21:08	43023.3	-033 18.3	006 34.3	
1993			142	02:38:00				34.47
1993			142	04:50:60				33.36
1993	PMG	SE	142	05:03:07	43015.3	-033 19.4	006 35.0	
1993	PMG	SE	142	05:19:30	43014.7	-033 19.1	006 35.2	
1993	PMG	SE	142	05:25:46	43014.2	-033 19.5	006 35.6	
1993	PMG	SE	142	05:40:45	43013.8	-033 19.5	006 35.8	
1993			142	05:50:00				32.01
1993			142	23:06:00				26.85
1993	PMG	SE	142	23:21:39	43040.2	-033 19.5	006 35.4	
1993	PMG	SE	142	23:33:30	43038.4	-033 19.4	006 35.4	
1993	PMG	SE	142	23:56:33	43037.9	-033 19.1	006 35.5	
1993			143	00:21:00				28.48
1993			143	23:06:00				27.35
1993	PMG	SE	143	23:25:10	43034.9	-033 18.2	006 35.1	
1993	PMG	SE	143	23:40:09	43037.0	-033 18.0	006 34.8	
1993	PMG	SE	143	23:53:25	43038.4	-033 18.0	006 34.8	
1993	PMG	SE	144	00:05:33	43039.0	-033 18.0	006 35.3	
1993			144	00:21:00				29.18
1993	PMG	A	144	00:59:15	43074.6	-033 22.1	006 34.3	
1993	PMG	A	144	01:20:39	43076.6	-033 22.2	006 34.2	
1993	PMG	A	144	01:31:45	43077.1	-033 22.3	006 34.0	
1993	PMG	A	144	01:50:13	43074.3	-033 22.3	006 33.9	
1993			144	23:06:00				26.42
1993	PMG	SE	144	22:40:50	43025.4	-033 19.9	006 35.3	
1993	PMG	SE	144	22:53:55	43027.0	-033 19.8	006 35.2	
1993	PMG	B	145	00:16:01	43218.8	-033 27.7	006 36.7	
1993	PMG	B	145	00:31:29	43220.6	-033 27.6	006 36.6	
1993	PMG	B	145	00:38:39	43219.3	-033 27.7	006 36.4	
1993	PMG	B	145	00:51:55	43217.3	-033 27.5	006 36.1	
1993	PMG	C	145	01:29:36	43185.7	-033 30.4	006 31.7	
1993	PMG	C	145	01:42:55	43184.6	-033 30.3	006 31.8	
1993	PMG	C	145	01:49:38	43183.9	-033 30.1	006 31.8	
1993	PMG	C	145	02:02:58	43183.5	-033 30.0	006 31.9	

1993			145	06:06:00				32.82
1993	PMG	SE	145	06:16:36	43029.6	-033 19.8	006 36.1	
1993	PMG	SE	145	06:29:04	43027.2	-033 19.8	006 37.1	
1993			145	06:39:00				31.50
1993			145	22:32:00				25.98
1993	PMG	SE	145	22:41:44	43045.3	-033 18.7	006 35.6	
1993	PMG	SE	145	22:54:46	43045.4	-033 18.7	006 34.8	
1993	PMG	SE	145	23:01:03	43045.0	-033 18.7	006 34.3	
1993	PMG	SE	145	23:12:51	43045.7	-033 18.6	006 34.2	
1993			145	23:21:00				27.06
1993			146	02:56:00				33.95

Port Moresby (08-11/June/1993 AML)

YEAR	SITE	STN	DAY	TIME	F	I	D	T
1993			159	04:21:00				32.89
1993	PMG	SE	159	04:36:46	42998.4	-033 20.7	006 36.1	
1993	PMG	SE	159	04:53:17	42993.8	-033 21.0	006 35.8	
1993	PMG	SE	159	05:00:10	42992.3	-033 20.5	006 36.4	
1993	PMG	SE	159	05:11:52	42991.8	-033 20.4	006 36.6	
1993			159	05:23:00				32.25
1993			159	22:40:00				26.11
1993	PMG	SE	159	22:56:51	43014.7	-033 19.9	006 34.0	
1993	PMG	SE	159	23:10:51	43017.8	-033 19.7	006 33.9	
1993	PMG	SE	159	23:16:16	43017.2	-033 20.0	006 33.4	
1993	PMG	SE	159	23:29:38	43018.2	-033 19.5	006 33.5	
1993	PMG	A	160	00:50:20	43049.1	-033 23.1	006 33.6	
1993	PMG	A	160	01:50:55	43046.7	-033 23.5	006 33.9	
1993	PMG	A	160	02:06:33	43041.9	-033 23.8	006 33.7	
1993	PMG	A	160	02:12:54	43041.3	-033 23.8	006 33.7	
1993			160	02:38:00				35.29
1993	PMG	A	160	04:58:56	43046.5	-033 23.7	006 36.3	
1993	PMG	A	160	05:14:34	43047.0	-033 23.6	006 36.1	
1993			160	06:08:00				33.02
1993	PMG	SE	160	06:21:30	43006.9	-033 20.7	006 36.1	
1993	PMG	SE	160	06:33:07	43005.8	-033 21.0	006 36.2	
1993	PMG	SE	160	06:39:09	43006.0	-033 21.1	006 36.2	
1993	PMG	SE	160	06:50:12	43004.6	-033 21.1	006 36.1	
1993			160	22:47:00				26.53
1993	PMG	SE	160	22:56:21	43020.8	-033 19.0	006 35.6	
1993	PMG	SE	160	23:08:05	43020.6	-033 19.0	006 35.5	
1993	PMG	SE	160	23:13:11	43020.3	-033 19.0	006 35.5	
1993	PMG	SE	160	23:24:09	43020.1	-033 19.3	006 35.3	
1993	PMG	B	161	01:01:49	43217.2	-033 27.2	006 37.0	
1993	PMG	B	161	01:15:38	43220.5	-033 27.2	006 37.0	
1993	PMG	B	161	01:21:32	43219.7	-033 27.0	006 37.0	
1993	PMG	B	161	01:33:58	43217.8	-033 27.1	006 37.1	
1993	PMG	C	161	01:47:37	43187.3	-033 30.6	006 32.4	
1993	PMG	C	161	02:00:51	43186.0	-033 30.6	006 32.3	
1993	PMG	C	161	02:06:27	43184.8	-033 30.9	006 32.5	
1993	PMG	C	161	02:18:47	43184.7	-033 30.9	006 32.4	
1993			161	05:31:00				31.44
1993	PMG	SE	161	05:45:25	43024.8	-033 20.2	006 35.5	
1993	PMG	SE	161	05:59:02	43022.3	-033 20.4	006 35.6	
1993	PMG	SE	161	06:04:28	43023.3	-033 20.1	006 35.7	
1993	PMG	SE	161	06:17:47	43021.4	-033 20.1	006 35.6	
1993			161	06:29:00				30.57
1993			161	23:24:00				27.38
1993	PMG	NM	162	00:03:21	43015.1	-033 20.2	---	
1993	PMG	NM	162	00:15:02	43017.0	-033 20.3	---	
1993	PMG	NM	162	00:19:53	43015.8	-033 20.3	---	
1993	PMG	NM	162	00:30:06	43020.3	-033 19.0	---	
1993	PMG	SE	162	00:40:09	43019.9	-033 20.3	006 34.0	
1993	PMG	SE	162	00:51:01	43020.6	-033 20.3	006 34.1	
1993	PMG	SE	162	00:56:02	43020.5	-033 19.8	006 34.2	
1993	PMG	SE	162	01:06:14	43024.3	-033 19.6	006 34.7	

Santa Cruz (14-18/June/1993 AML)

YEAR	SITE	STN	DAY	TIME	F	I	D	T
1993			165	21:58:00				28.10
1993	SCZ	A	165	23:50:50	41224.6	-031 08.1	010 13.5	
1993	SCZ	A	166	00:06:06	41222.3	-031 08.0	010 13.5	
1993	SCZ	A	166	00:18:13	41223.3	-031 08.1	010 13.5	
1993	SCZ	A	166	00:30:16	41225.6	-031 08.0	010 13.2	
1993			166	02:30:00				29.49
1993	SCZ	A	166	04:53:27	41189.4	-031 07.4	010 15.1	
1993	SCZ	A	166	05:04:22	41186.9	-031 07.5	010 15.2	
1993	SCZ	A	166	05:18:46	41184.6	-031 07.6	010 15.8	
1993	SCZ	A	166	05:31:14	41183.3	-031 07.8	010 15.6	
1993	SCZ	A	166	22:06:46	41216.3	-031 07.9	010 14.1	
1993	SCZ	A	166	22:18:27	41217.8	-031 07.9	010 14.0	
1993	SCZ	A	166	22:28:21	41220.3	-031 07.9	010 13.9	
1993	SCZ	A	166	22:38:46	41222.2	-031 07.9	010 13.8	
1993	SCZ	A	166	22:50:47	41223.6	-031 07.9	010 13.8	
1993	SCZ	A	166	23:01:18	41223.9	-031 07.9	010 13.7	
1993			167	01:05:00				28.74
1993	SCZ	B	167	02:00:16	41249.3	-031 09.2	010 16.5	
1993	SCZ	B	167	02:19:20	41247.9	-031 09.1	010 16.7	
1993	SCZ	B	167	02:27:06	41246.8	-031 09.0	010 16.7	
1993	SCZ	B	167	02:44:13	41242.2	-031 09.1	010 16.7	
1993	SCZ	A	167	05:09:24	41203.6	-031 07.2	010 15.5	
1993	SCZ	A	167	05:20:50	41202.8	-031 07.2	010 15.6	
1993	SCZ	A	167	21:17:30	41209.8	-031 07.4	010 15.5	
1993	SCZ	A	167	21:54:19	41211.4	-031 07.8	010 15.0	
1993	SCZ	A	167	22:08:26	41210.8	-031 07.8	010 14.8	
1993	SCZ	A	167	22:21:31	41211.9	-031 08.0	010 14.7	
1993	SCZ	A	168	05:10:29	41210.7	-031 07.3	010 15.0	
1993	SCZ	A	168	05:20:44	41208.4	-031 07.5	010 15.1	
1993	SCZ	A	168	05:30:49	41207.8	-031 07.5	010 15.0	
1993	SCZ	A	168	05:41:18	41206.8	-031 07.6	010 15.0	
1993	SCZ	A	168	21:32:47	41204.0	-031 07.7	010 15.0	
1993	SCZ	A	168	21:44:22	41205.2	-031 07.7	010 15.1	
1993	SCZ	A	168	21:55:30	41205.0	-031 07.8	010 15.1	
1993	SCZ	A	168	21:46:13	41206.8	-031 07.9	010 14.9	

Wewak (04-06/June/1993 AML)

YEAR	SITE	STN	DAY	TIME	F	I	D	T
1993	WEW	D	155	07:44:50	40471.1	-023 48.4	004 51.6	
1993	WEW	D	155	08:01:11	40462.8	-023 48.4	004 51.6	
1993	WEW	D	155	23:40:37	40505.8	-023 49.0	004 49.1	
1993	WEW	D	155	23:49:57	40509.2	-023 49.2	004 49.4	
1993	WEW	D	155	23:57:52	40511.3	-023 49.1	004 49.6	
1993	WEW	D	156	00:06:29	40512.8	-023 49.1	004 49.4	
1993	WEW	E	156	01:38:43	40537.5	-023 50.1	004 49.5	
1993	WEW	E	156	01:51:54	40519.4	-023 49.7	004 49.3	
1993	WEW	E	156	01:58:39	40511.8	-023 49.2	004 48.8	
1993	WEW	E	156	02:11:43	40521.4	-023 49.2	004 49.0	
1993			156	03:00:00				32.27
1993			156	03:17:00				32.72
1993			156	05:05:00				31.92
1993	WEW	D	156	05:58:38	40493.8	-023 48.9	004 50.7	
1993	WEW	D	156	06:07:16	40496.4	-023 48.9	004 51.0	
1993	WEW	D	156	06:14:49	40495.3	-023 48.8	004 50.9	
1993	WEW	D	156	06:21:25	40495.8	-023 48.8	004 51.0	
1993			156	06:58:00				27.89
1993			156	22:17:00				26.62
1993	WEW	D	156	23:02:59	40513.8	-023 48.6	004 50.2	
1993	WEW	D	156	23:10:44	40515.6	-023 48.6	004 50.1	
1993	WEW	D	156	23:18:21	40518.2	-023 48.6	004 49.9	
1993	WEW	D	156	23:25:21	40519.2	-023 48.6	004 49.8	
1993	WEW	E	157	00:04:24	40527.8	-023 49.5	004 50.1	

1993	WEW	E	157	00:19:00	40528.7	-023 49.4	004 50.1	
1993	WEW	E	157	00:25:16	40530.4	-023 49.4	004 49.9	
1993	WEW	E	157	00:36:53	40530.8	-023 49.2	004 49.7	
1993	WEW	D	157	01:13:02	40529.4	-023 47.4	004 47.1	
1993	WEW	D	157	01:40:60	40520.4	-023 46.7	004 46.6	
1993	WEW	D	157	01:48:22	40515.9	-023 46.7	004 46.5	
1993	WEW	D	157	01:54:48	40518.8	-023 46.8	004 46.8	
1993			157	02:25:00				30.08
1993			157	05:39:00				29.99
1993	WEW	D	157	06:08:59	40501.8	-023 47.5	004 51.1	
1993	WEW	D	157	06:15:22	40497.2	-023 47.4	004 51.2	
1993	WEW	D	157	06:22:21	40492.7	-023 47.4	004 51.1	
1993	WEW	D	157	06:28:49	40487.2	-023 47.4	004 51.1	
1993			157	07:23:00				29.35
1993			157	20:48:00				26.12
1993	WEW	D	157	21:25:05	40522.0	-023 48.9	004 51.8	
1993	WEW	D	157	21:31:26	40522.1	-023 49.0	004 51.7	
1993	WEW	D	157	21:37:46	40523.5	-023 49.1	004 51.8	
1993	WEW	D	157	21:44:52	40524.1	-023 49.1	004 51.9	
1993			157	22:14:00				27.08

Hourly Mean Value Tables

1993 MAY **Horizontal intensity (H)**

Day	UT	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	FINAL HOURLY MEAN VALUES 21	22	23	24	Mean
01		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
04		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	Q	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Port Moresby										35500 + tabular values in nanoTeslas.																
22	Q	456	456	456	447	446	442	440	443	447	445	442	441	443	444	446	445	444	445	444	447	448	456	463	463		448
23	Q	467	471	469	464	459	449	440	438	439	439	439	436	436	437	431	430	433	436	438	441	447	455	460	468		447
24	Q	476	477	473	468	-	448	439	435	439	444	442	440	435	433	434	436	437	440	444	444	447	448	448	453		-
25	Q	458	461	469	471	470	-	450	448	450	450	449	448	446	446	447	447	448	-	451	453	457	465	471	476		-
26		486	492	491	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Kavieng										36500 + tabular values in nanoTeslas.																
28	D	-	-	-	-	12	14	14	10	12	11	-3	5	4	5	7	10	7	5	8	6	14	23	30	35		-
29		39	34	20	24	28	29	19	14	16	7	-3	0	7	8	10	13	15	17	20	22	29	38	41	48		21
30		53	53	50	45	38	31	23	22	24	24	22	21	20	18	18	19	20	20	21	27	33	38	46	49		31
31		48	46	41	41	41	41	37	36	35	34	29	29	24	22	18	21	24	25	28	30	34	40	47	54		34

Q and D indicate International Quiet and Disturbed days respectively.

1993 JUNE **Horizontal intensity (H)** FINAL HOURLY MEAN VALUES

Day	UT	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Mean
01	Q	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Wewak									37000 + tabular values in nanoTeslas.																
04	D	-	-	-	-	-	-	-	-1	3	-53	-7	-31	-3	-11	4	3	8	13	24	40	38	43	45	40	-	
05	D	37	56	43	32	24	18	25	23	15	1	5	26	9	17	24	27	36	33	30	35	37	44	46	54	29	
06		62	64	70	60	60	55	29	14	14	20	27	38	34	35	41	42	37	36	37	32	36	54	59	-	-	
07	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Port Moresby									35500 + tabular values in nanoTeslas.																
08		-	-	-	-	418	422	426	422	421	418	413	416	418	420	422	419	422	420	422	421	428	430	435	443	-	
09		450	446	439	441	440	438	426	423	422	419	415	411	410	411	412	415	420	422	422	425	428	435	445	450	428	
10	D	459	462	457	450	453	447	439	428	422	418	417	420	422	429	430	431	434	443	454	459	457	448	404	437	438	
11		442	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
12		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
13		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Santa Cruz									35000 + tabular values in nanoTeslas.																
14		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	278	281	284	-	
15		287	285	274	264	261	257	-	255	258	262	263	263	263	263	264	265	266	266	266	268	275	278	283	287	-	
16	Q	289	292	291	285	278	273	-	263	263	265	265	266	265	266	267	268	270	269	270	275	280	278	277	285	-	
17		292	296	294	288	284	277	-	270	268	269	270	271	272	274	275	274	273	273	271	273	272	271	275	280	-	
18	Q	280	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
19		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Honiara									35500 + tabular values in nanoTeslas.																
20		-	-	59	56	44	27	13	5	11	15	17	15	15	16	17	19	20	21	24	29	35	35	38	37	-	
21	Q	47	51	57	58	42	36	30	30	32	31	31	31	32	34	35	36	37	38	40	43	49	53	61	69	42	
22		77	80	80	74	62	46	34	27	24	21	22	25	27	29	29	30	30	31	37	38	43	45	50	-	-	
23		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
24	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Noumea									32000 + tabular values in nanoTeslas.																
25		-	-	-	-	-	-	258	261	252	239	242	243	250	260	260	257	258	259	261	266	277	282	280	278	-	
26		281	278	269	264	256	258	264	266	263	264	264	264	264	266	267	270	270	271	273	277	284	284	281	280	270	
27		281	285	276	267	266	270	274	273	264	262	264	263	266	267	270	270	269	273	275	278	286	291	290	289	274	
28	Q	291	295	292	286	277	276	276	277	275	271	274	278	278	277	275	276	276	279	283	289	296	298	298	302	283	
29		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
30		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Q and D indicate International Quiet and Disturbed days respectively.

1993 MAY — **Declination East (D)** — FINAL HOURLY MEAN VALUES

Day	UT	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Mean
01		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
04		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	Q	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Port Moresby										6 Deg + tabular values in 0.1 min															
22	Q	338	339	341	339	347	356	364	363	359	357	356	354	355	356	357	359	362	363	362	363	369	370	361	355		356
23	Q	352	349	349	350	353	355	356	358	355	355	355	352	351	351	351	353	356	356	355	356	362	363	355	351		354
24	Q	344	333	330	331	-	356	357	356	356	354	352	350	348	348	351	353	354	355	356	355	360	361	354	347		-
25	Q	337	335	347	356	358	-	362	361	358	356	355	353	353	354	356	358	359	-	360	361	368	367	352	340		-
26		335	330	328	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
27		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
		Kavieng										6 Deg + tabular values in 0.1 min															
28	D	-	-	-	-	247	253	257	257	251	248	245	244	243	244	244	243	242	245	246	249	252	249	236	231		-
29		231	230	227	232	245	255	257	253	248	248	243	243	242	242	243	244	245	248	249	249	254	251	241	234		244
30		232	229	227	239	259	263	259	254	250	248	246	244	243	243	243	244	245	246	248	247	251	250	244	239		246
31		234	234	236	240	252	262	263	257	249	247	247	245	245	243	244	246	248	248	248	247	249	246	237	230		246

Q and D indicate International Quiet and Disturbed days respectively.

1993 JUNE **Declination East (D)** FINAL HOURLY MEAN VALUES

Day	UT	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Mean
01	Q	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Wewak									4 Deg + tabular values in 0.1 min																
04	D	-	-	-	-	-	-	-	530	527		524	532	524	525	522	521	529	530	534	536	537	545	543	532	514	-
05	D	508	497	486	481	481	506	529	532	523		528	524	519	526	528	526	525	529	529	534	533	532	536	528	514	519
06		496	487	486	490	508	522	528	529	538		534	531	528	526	527	526	526	527	530	533	545	562	537	537	-	-
07	D	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Port Moresby									6 Deg + tabular values in 0.1 min																
08		-	-	-	-	360	366	365	361	354		353	355	353	353	354	355	358	358	361	363	367	367	365	351	334	-
09		329	330	332	341	350	357	361	360	356		355	354	356	357	358	359	361	363	362	362	361	363	365	360	352	354
10	D	341	336	334	341	350	355	357	357	360		360	360	357	356	355	355	355	359	360	361	364	362	360	363	366	355
11		343	346	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12		-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13		-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Santa Cruz									10 Deg + tabular values in 0.1 min																
14		-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	147	144	137	-
15		133	129	132	140	151	155	-	143	142		139	139	138	138	138	139	142	143	143	144	148	151	146	138	134	-
16	Q	131	130	137	146	153	155	-	146	143		141	138	138	138	138	139	141	143	143	144	150	156	153	146	142	-
17		140	136	133	138	148	152	-	145	144		143	142	141	141	143	144	143	143	145	143	148	153	151	147	142	-
18	Q	136	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19		-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Honiara									9 Deg + tabular values in 0.1 min																
20		-	-	346	355	365	366	365	361	355		352	350	349	348	348	350	350	351	354	356	358	366	361	352	343	-
21	Q	338	337	340	346	356	362	364	359	354		352	350	349	350	352	353	355	357	359	361	364	372	369	350	340	354
22		331	326	330	338	353	359	358	353	351		348	345	346	347	348	351	354	356	358	356	356	363	363	360	-	-
23		-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	D	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Noumea									12 Deg + tabular values in 0.1 min																
25		-	-	-	-	-	-	576	573	573		560	568	565	564	560	559	567	570	572	573	575	577	570	558	549	-
26		549	551	566	583	589	585	576	573	571		569	566	566	565	565	565	567	568	570	571	571	576	570	565	556	569
27		550	542	556	573	587	583	573	572	573		570	567	565	564	564	563	562	564	567	568	569	573	568	559	553	566
28	Q	552	552	564	574	580	579	572	569	568		567	564	564	562	562	562	564	566	567	567	569	572	567	558	551	565
29		-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30		-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Q and D indicate International Quiet and Disturbed days respectively

1993 MAY **Vertical intensity (Z)** FINAL HOURLY MEAN VALUES

Day	UT	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Mean
01			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
04			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08	D		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09	D		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	D		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	D		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	Q		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Port Moresby										-23500 - tabular values in nanoTeslas.															
22	Q		123	124	124	131	128	130	133	136	137	140	144	144	143	142	142	142	143	141	142	139	136	140	145	144	137
23	Q		136	133	133	135	137	141	144	144	143	142	143	146	145	145	148	146	144	143	142	141	136	136	135	130	140
24	Q		131	139	135	130	-	136	144	145	142	140	143	145	148	146	145	144	143	142	142	142	138	140	142	138	-
25	Q		134	128	115	120	126	-	143	142	141	140	142	143	143	142	142	142	142	-	143	141	136	139	141	134	-
26			122	119	119	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Kavieng										-13500 - tabular values in nanoTeslas.															
28	D		-	-	-	-	342	348	351	352	354	354	349	355	356	357	358	358	356	357	358	357	359	365	367	363	-
29			360	351	339	340	340	343	346	349	352	349	347	353	357	359	359	360	360	360	360	358	359	361	364	367	354
30			366	360	357	345	339	342	345	348	351	352	352	353	354	355	356	358	359	358	358	360	360	362	362	359	355
31			357	356	354	354	352	349	350	351	350	350	349	352	351	353	353	355	357	358	359	359	358	359	363	364	355

Q and D indicate International Quiet and Disturbed days respectively.

1993 JUNE **Vertical intensity (Z)** FINAL HOURLY MEAN VALUES

Day	UT	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Mean
01	Q	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Wewak -16000 - tabular values in nanoTeslas.																									
04	D	-	-	-	-	-	-	-	341	351	323	369	349	370	361	370	369	370	372	376	384	381	382	381	371		-
05	D	366	372	346	332	324	341	359	361	355	352	356	369	359	366	368	367	371	368	368	370	369	373	370	368		360
06		363	353	350	342	350	353	344	345	355	359	365	371	366	367	370	369	366	368	371	387	390	377	377	-		-
07	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
		Port Moresby -23500 - tabular values in nanoTeslas.																									
08		-	-	-	-	132	128	132	139	140	141	141	140	139	140	140	142	140	141	139	140	134	137	137	136		-
09		134	136	138	140	141	139	142	142	141	142	142	142	141	140	140	139	138	139	140	139	136	134	132	132		139
10	D	132	132	136	137	139	143	145	146	144	143	142	140	139	137	138	138	136	133	131	132	133	140	156	132		138
11		142	138	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
12		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
13		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
		Santa Cruz -21000 - tabular values in nanoTeslas.																									
14		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	305	308	314		-
15		315	314	308	299	292	289	-	302	305	308	308	309	309	309	307	305	304	303	302	299	299	304	311	315		-
16	Q	317	314	307	300	296	295	-	302	304	306	308	309	310	310	309	307	305	304	303	299	297	302	309	312		-
17		313	316	319	314	306	301	-	305	305	306	308	309	309	309	309	308	307	305	305	300	298	301	306	311		-
18	Q	315	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
19		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
		Honiara -20500 - tabular values in nanoTeslas.																									
20		-	-	343	346	352	357	361	364	362	362	362	364	364	364	365	364	363	362	361	358	358	361	361	362		-
21	Q	360	356	355	354	355	357	360	362	360	360	360	360	361	362	362	363	362	361	361	359	358	358	356	354		359
22		357	358	351	347	348	353	357	358	358	358	357	357	357	358	360	360	361	362	360	359	357	356	355	-		-
23		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
24	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
		Noumea -35500 - tabular values in nanoTeslas.																									
25		-	-	-	-	-	-	458	457	464	467	469	467	465	461	462	463	462	462	460	458	453	453	451	447		-
26		441	439	439	441	442	445	451	456	459	461	461	462	461	460	460	459	459	458	458	456	455	456	458	455		454
27		454	449	449	449	446	444	449	455	460	461	461	462	461	460	458	458	457	455	455	453	449	448	448	450		454
28	Q	451	450	447	445	443	446	451	455	457	459	458	458	458	458	458	457	457	454	453	451	450	452	455	454		453
29		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
30		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-

Q and D indicate International Quiet and Disturbed days respectively.

1993 MAY **Total intensity (F)** FINAL HOURLY MEAN VALUES

Day	UT	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Mean
01		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
04		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	Q	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Port Moresby											43000 + tabular values in nanoTeslas.															
22	Q	22	22	22	19	16	14	14	18	22	22	21	21	22	23	24	24	23	22	22	23	23	31	40	39	23
23	Q	38	40	38	35	32	26	21	18	19	19	18	18	17	18	15	13	14	16	17	20	22	28	31	36	24
24	Q	43	48	43	36	-	22	19	16	18	21	21	21	18	16	15	16	17	19	22	23	23	25	26	28	-
25	Q	30	29	28	33	35	-	28	26	27	26	27	26	25	24	25	25	26	-	29	29	30	38	44	44	-
26		46	50	49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Kavieng											39000 + tabular values in nanoTeslas.															
28	D	-	-	-	-	48	51	53	49	52	51	37	46	45	47	49	51	48	46	50	47	56	66	73	76	-
29		79	72	54	58	62	64	56	53	55	45	35	40	48	50	52	55	57	59	62	63	70	79	83	90	60
30		95	93	89	79	71	65	59	59	62	63	61	60	59	58	58	60	61	61	62	68	73	79	86	89	70
31		87	84	80	79	78	77	74	73	72	71	67	67	62	61	57	61	65	66	69	71	74	80	88	94	73

Q and D indicate International Quiet and Disturbed days respectively.

1993 JUNE **Total intensity (F)** FINAL HOURLY MEAN VALUES

Day	UT	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Mean
01	Q		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Wewak									40000 + tabular values in nanoTeslas.																
04	D		-	-	-	-	-	-	-	447	455	392	453	423	457	446	463	462	467	472	484	502	499	504	505	496	-
05	D		491	512	490	474	463	464	478	477	467	453	459	483	463	473	481	483	493	489	486	492	493	501	502	508	482
06			513	511	515	503	507	503	476	462	466	474	482	495	489	490	497	498	492	492	494	496	501	512	516	-	-
07	D		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Port Moresby									43000 + tabular values in nanoTeslas.																
08			-	-	-	-	-5	-4	2	3	2	0	-4	-2	0	1	3	1	3	2	2	1	5	8	12	18	-
09			23	21	16	19	19	16	7	4	4	1	-2	-5	-6	-7	-6	-4	0	2	2	4	6	10	17	22	7
10	D		29	32	30	25	28	26	19	11	5	1	0	1	3	7	8	9	11	17	25	29	28	24	-4	11	16
11			21	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Santa Cruz									41000 + tabular values in nanoTeslas.																
14			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	212	217	222	-
15			225	223	210	197	191	186	-	191	194	200	201	202	201	201	201	201	202	201	201	201	206	212	220	226	-
16	Q		228	229	224	216	207	203	-	198	199	202	203	204	203	204	205	205	205	204	205	206	210	210	213	222	-
17			228	233	233	225	217	210	-	206	204	204	206	209	210	211	211	211	209	208	206	205	203	205	210	216	-
18	Q		220	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Honiara									41000 + tabular values in nanoTeslas.																
20			-	-	218	217	209	197	186	182	186	189	191	189	190	191	192	194	194	194	196	200	204	206	208	208	-
21	Q		215	217	222	223	209	205	201	202	202	202	202	202	203	205	206	208	208	209	210	212	216	219	226	231	211
22			240	243	240	233	223	211	203	198	195	192	193	195	197	199	200	201	202	203	207	208	211	212	216	-	-
23			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	D		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Noumea									48000 + tabular values in nanoTeslas.																
25			-	-	-	-	-	-	307	308	307	301	304	304	307	310	311	310	310	310	311	312	316	319	316	312	-
26			310	306	300	299	294	297	306	311	312	313	313	314	314	314	315	315	315	316	317	318	322	323	322	320	312
27			320	318	312	306	303	304	311	315	313	312	314	313	314	315	315	315	314	315	316	317	319	321	321	322	314
28	Q		324	325	321	316	308	310	314	317	318	317	318	320	320	320	318	318	318	318	320	322	326	329	331	333	320
29			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Q and D indicate International Quiet and Disturbed days respectively.