

Annual

Report Summary

1999

**South
Pacific
Applied
Geoscience
Commission**

SOPAC

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Foreword by the Director



Alf Simpson

I start with the reminder that this summary report covers the period October '98 to September '99 and not the 1999 calendar year. The reason being that it coincides with the period between Annual Sessions.

I am conscious of the utility of such a document and that it is not be perceived as another reporting chore by the Secretariat. We do in fact produce a fair amount of documentation informing our membership and other interested parties about SOPAC and its programs. It would be nice to believe that you all read and absorb everything we produce. I suspect this is not the case therefore this Annual Report Summary takes on an added responsibility. If it is to be the only report you read about SOPAC it must be informative as well as factual and comprehensive yet to the point.

I trust we have taken on board comments relating to how we might improve this report. One of the requests was to show where the funding for our programs was coming from and this we have done. The other request was to report outcomes against key result areas. This has not been incorporated in this report but in the way that our 2001 Work Program and Budget is presented.

Please remember this report is a low budget, in-house produced effort, however, I hope the picture it conveys is that of a strong and vibrant regional organisation.

Last year I stated that the approved 1999 budget was FJD\$8.5 million. The actual expenditure turned out to be FJD\$7.7 million. The approved 2000 budget is FJD\$9.1 million. The work output by the Secretariat continues to grow. Ocean management, an activity that has been without support for a number of years raises itself from the ashes with some generous support by Taiwan. Disaster Management and the UN SPRDP in particular received passing comment last year but is more fully reported on in this report. Disaster management, not disasters, is the latest growth area for the SOPAC. I am certain that future reports will reflect its effective assimilation into the overall SOPAC Work Program as the Forum Leaders directed.

Through the activity profiles, stakeholders have been able to obtain a snapshot of SOPAC and its capabilities. In 1999 we launched the draft country profiles in an attempt to show what SOPAC does for its members. The publishing of the final product will coincide with the release of this report. I trust you will find the country profiles as useful as we think they should be.

Finally I draw your attention to the SOPAC – SPC Integration study, an initiative floated together with SPC during our respective 1999 governing body meetings. An eminent group of regional experts have been appointed to carry out the study and report back to governing bodies during 2000. It is hoped that the exercise will address many issues related to the future roles of the two organisations. Whatever the outcome I am sure it will be in the best interests of the region.

A handwritten signature in black ink, appearing to be 'Alf Simpson'.

Alf Simpson
Director

August 2000

Introduction to SOPAC

What is SOPAC?

SOPAC is the South Pacific Applied Geoscience Commission. It is an intergovernmental, regional organisation dedicated to providing geological services to promote sustainable development in the countries it serves. SOPAC's work is carried out through its Secretariat, based in Suva. The work program is reviewed annually by the Governing Council assisted by: Secretariat representatives (SOPAC), a Technical Advisory Group (TAG), and a Science, Technology and Resources Network (STAR). SOPAC is funded by member-country contributions with support from donors.

What does SOPAC do?

SOPAC's work focuses on providing assistance to its member countries in 3 key areas: minerals, and energy resource identification, promotion, and development; environmental geoscience issues; and human resource development in the geoscience field and disaster management. To effectively provide these services SOPAC maintains an information technology unit, provides publication and library services, and offers technical and field services for specific project work.

Who benefits from SOPAC?

Member countries are Australia, Cook Islands, Federated States of Micronesia, Fiji Islands, Guam, Kiribati, Marshall Islands, Nauru, New Zealand, Niue, Papua New Guinea, Samoa, Solomon Islands, Kingdom of Tonga, Tuvalu, and Vanuatu. French Polynesia and New Caledonia are associate members. Any island member country can request assistance from SOPAC.

Benefits accrue to island member countries directly through the provision of basic geological knowledge. And indirectly, through improvements in land and ocean use, leading to improved health through improved water and sanitation provision, wealth generation through the development of mineral resources, hazard and disaster management and more sustainable development by taking into account the geo-environmental impacts of developments.

Who pays for SOPAC?

SOPAC is funded by member-country contributions and supported by the following donors: Australia, Fiji Islands, Canada, France, Japan, Korea, New Zealand, People's Republic of China, Taiwan, the United Kingdom, the USAID/GII, the Commonwealth Secretariat, the European Union, and the UN family. Where donors have provided assistance for specific activities in the work program, either at the regional or country level, this is acknowledged in this Annual Report Summary.

General Regional Assistance

Not all of the services provided by SOPAC are required by all countries. The resource-rich Melanesian countries generally request SOPAC's assistance to promote or develop their mineral or petroleum potential. The smaller Micronesian and Polynesian countries, which are commonly more isolated with fewer exploitable resources, have other needs, more often related to the assessment of causes of coastal erosion, groundwater and sanitation improvements.

Those activities in 1999 which have provided assistance to the region as a whole, or to groups of countries are included in this section on regional assistance.

Resource Development Program

The resource development program covers a broad spectrum of activities including assisting countries in the search for viable mineral deposits including aggregates and hydrocarbons both onshore and offshore, assisting countries in the development of adequate quantities of safe drinking water and sanitation facilities, and investigating alternative sources of energy.

Mineral Resources

The objective of the Mineral Resources Unit is to provide technical assistance and policy advice on the sustainable management and development of offshore and onshore mineral resources.



Earth Science and Marine Geology course students on a field trip in Fiji.

The South Pacific region is endowed with mineral occurrences both offshore and onshore, and the island countries have some of the world's greatest potential for onshore and offshore minerals. Several of the largest world's copper, gold and cobalt deposits occur in the South Pacific region, namely the Porgera and Lihir gold deposits, Bougainville copper mine in Papua New Guinea (PNG), Namosi copper deposit in Fiji and the manganese nodules deposit in the EEZ of the Cook Islands. Mineral exploration activity in the region continued to be vigorous with an estimated A\$30 million being spent in exploration during the past year

Most of the South Pacific countries are relatively small, with poorly-developed infrastructure and a high level of reliance on imported material for subsistence and commercial activities. Although some of the Pacific islands have great potential for mineral wealth, as a whole, they cannot access and utilise this potential because of severe resource limitations and a lack of in the skilled human resource base.

A draft land-based minerals regional policy paper was produced during the year.

An offshore mineral resources expert group was convened by SOPAC in Madang, Papua New Guinea in February 1999 to address issues of new policy and legislative regimes that effectively manage issues arising from offshore mineral exploration and development. It was recommended that SOPAC produce a set of guidelines as international standards for offshore prospecting and mining. The Madang Guidelines, a set of recommendations arising from this workshop was published in December 1999. The Madang Guidelines provide a useful basis for assisting nations of the international community in their formulation of effective policy and legislation for offshore mineral development.

Appreciating the huge success and benefits gained from the three 5-year phases of SOPAC-Japan Deep Sea Minerals Program, SOPAC member countries continued to strongly request Japan to consider a new program. Meetings with the Japanese Embassy and MMAJ were held to initiate this new phase. As part of the final year of activity of the current program, two surveys in the Fiji waters were conducted during May to June 1999 with the *Hakurei Maru No. 2* to assess the potential of hydrothermal ore deposits in the North Fiji Basin. Bathymetry, subsurface, magnetic data,



Earth Science and Marine Geology course students at a water supply utility in Fiji.

bottom sediment and rock samples were collected during the survey. Drilling into the sulphide deposit was also conducted during the second leg of the survey. Two staff from the Department of Mineral Resources participated in the survey as trainees.

SOPAC continued to maintain and expand its deepsea mineral databases (especially for manganese nodules, cobalt-rich crusts, metalliferous sediments and hydrothermal minerals); and compiled and published regional maps as required.

In 1999 work carried out by the Petroleum Databank based at AGSO continued to maintain access and update of data for hydrocarbon assessment and promotion of data packages to the oil industry.

Updating of the Petroleum Data Catalogues for Solomon Islands, Vanuatu, Fiji Islands and Tonga was ongoing. These catalogues supplement the glossy brochures covering the petroleum prospects of the island nations.

Compilation of information on area, legislation, well data availability etc., for SOPAC countries, to be included by Integrated Exploration and Development Services (IEDS) in their publications of petroleum potential was completed.

Production in digital format of the Fiji Islands and Vanuatu petroleum brochures and catalogues was completed. Review and updating of the Solomon Islands and Tonga petroleum brochures with a view to digitising in 2000 has been completed.

Water Resources

A workshop with 25 participants from 14 countries on water demand management was held in Nadi from the 21 to 26 July. SOPAC member countries represented were: Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, New Zealand, Niue, Papua New Guinea, Samoa, Solomon Islands, Kingdom of Tonga, Tuvalu and Vanuatu.

A Small-Scale Wastewater Treatment project investigated appropriate wastewater treatment technologies to accommodate small groups of dwellings in the Fiji Islands, Marshall Islands, Tonga and Niue. The results of the project have been disseminated to all member countries. Pilot project areas have been identified and follow-up project proposals submitted to potentially interested donors.

Special training was provided through attachments to Tonga, the Marshall Islands, Kiribati and the Solomon Islands.

The Secretariat continued to act as coordinating centre for water and sanitation activities in the region.

A regional database system for member countries to store and retrieve water and sanitation information continued to be developed.

SOPAC with funding assistance from the UK Government organised a regional school competition, a public forum in Fiji and information packages for all member countries to mark World Water Day 1999.

A preliminary assessment of the impacts of the 1997-98 El Niño event was undertaken in selected Pacific countries. The capacity to manage these impacts in the future was evaluated by reviewing in-country systems for monitoring conditions and trends. A workshop on ENSO Impacts on Water Resources was held in Nadi from 19-23 October attended by representatives of all SOPAC Member Countries and other Pacific island states.

The past El Niño has shown that many PICs are vulnerable to droughts. A report was prepared to provide information to all member countries to assist consideration of desalination as a technically and economically viable option.

Energy

During 1999, the Energy Unit continued to consolidate its earlier transfer from the Forum Secretariat and continues to not only deliver its previous level of services to member countries but has also opened up a number of new opportunities for future funding and energy sector activities. These activities have been developed and implemented within the context of the framework of the SPC-SOPAC Joint Regional Programme Design Report.

The Energy Unit has taken an active role in the new CROP Energy Working Group (EWG). The first meeting was convened at the IGPO (International Greenhouse Partners Office) Workshop in Nadi in July, with the second meeting in Suva in November 1999.

One of the key initial activities in particular is to provide advice and co-ordinate the preparation of briefs and presentations of the region's preparations for the 9th session of the UN Commission for Sustainable Development in 2001.

The appointment of an Energy Project Officer in January 1999 on a consultancy basis assisted in further expanding the energy program specifically in the development of energy databases. This also added another dimension to counterpart training for SOPAC with the longer-term view to sustainability of energy programs in the region. The establishment of the energy database has also proven to be useful in the preparation of individual country national communications and greenhouse gas inventories as required under the Kyoto Protocol.

The energy supply and demand side databases and manuals have been modified for Kiribati, Marshall Islands, Nauru, Niue, Tonga and Papua New Guinea. The energy database was re-installed in Marshall Islands, Kiribati and Nauru.

A sub-regional workshop on energy database, data collection, inputting, and management was convened in Pohnpei for the FSM States, Nauru, Guam, Marshall Islands and Palau. (Note Guam and Palau did not attend the workshop.)

The unit continued to assist with the collection of petroleum supply and demand data from oil companies. In Kiribati assistance was also provided in the preparation of the initial components for an energy statistics year-book.

The International Institute for Sustainable Development (IISD) Canada funded an intern who commenced work on developing an energy technology and information knowledge database and



Downloading data — Tonga Solar Hot Water Monitoring Project.



Energy Database Workshop, Federated States of Micronesia.

manual. The database will provide a record of a wide as possible range of energy focused technologies, projects and experience within the region for both the renewable and non-renewable energy sectors.

Two training workshops on wind data analysis were convened in the Fiji Islands. Participation at the workshops was from Fiji Department of Energy and from the Tonga Energy Office as part of a wider focused energy training attachment.

Assistance was provided to Tonga and the Cook Islands in respect to the improved operation, management, financial and maintenance aspects necessary for the sustainable develop-

ment of their solar utilities. Specific follow-up assistance and monitoring of progress with the implementation of assistance previously provided to Kiribati, Tuvalu and the Marshall Islands was provided in respect to the improved operation, management, financial and maintenance aspects necessary for the sustainable development of their solar utilities.

Phase II of the Regional Wood Stoves Programme was successfully completed with the construction of two institutional wood stoves in Kiribati, Tonga and Tuvalu.

Support by member countries for the Regional Pacific-Danish Environmental Education and Action Program in its revised format was given at the 1999 Annual Session and confirmation of funding by the Danish Government was received in December 1999. The revised proposal focuses on capacity-building, the development of national professional staff skills in relation to the installation and operation of wind loggers, and the design, implementation and operation of a wind turbine. The program is scheduled to commence in March 2000.

Energy Unit staff visited and provided technical assistance to the Federated States of Micronesia, Fiji, Guam, Kiribati, Marshall Islands, Nauru, Niue, Samoa, Tonga, Tuvalu on general energy sector program activities. This included assistance in energy planning and management, policy development, energy database, energy efficiency and conservation.

A consultancy service was provided to the Asian Institute of Technology (AIT) for the preparation of energy data, indicators and statistics reports for Fiji, Tonga, Niue, Samoa, Tuvalu, Kiribati, Solomon Islands, Vanuatu and Papua New Guinea.

As part of an energy audit and reporting on the Secretariat's energy consumption and the identification of opportunities for reducing the use of energy a project was developed within the SOPAC Secretariat to demonstrate the use of solar PV for providing power for communication and security night lighting when mains power is interrupted. The performance of the project is being monitored and the financial and economic viability will be reported to members. A separate detailed report for the energy audit identifying opportunities for improving energy efficiency and conservation will be prepared. These reports will be circulated to member countries during 2000.

The Energy Unit has prepared a technical publication on Solar Hot Water systems and this will be published in 2000. The technical publication follows on from earlier work of the Energy Unit in developing a financial and economic template comparing the cost of hot water produced from solar, gas and electricity. A project including resource monitoring and the comparison of system efficiency of locally manufactured and imported solar hot water systems continues in Fiji (Suva and Nadi) and Tonga.

The Energy Unit recommenced the publication of PEN (Pacific Energy News) in July 1999 with a second issue being published in October. It is proposed that this will resume as a quarterly publication and members are encouraged to contribute to this publication. The PEN is aimed at keeping member countries informed on energy issues, technologies, and up and coming events. The PEN has been distributed to all energy offices, donors, power utilities, solar co-operatives, technical and training institutes and energy related NGO's.

At the G77 Minister's Meeting in September funding for the training component of a Regional Biomass Resource Assessment Project was confirmed. The funding is provided through the UN Perez Guerrero Trust Fund for Economic and Technical Co-operation among developing countries. It is anticipated that the Project will commence in the middle of 2000.



The full suite of the new multibeam mapping system acquired at the beginning of 1999. The purchase of the RESON SeaBat system was made possible through a cost-sharing exercise between SOPAC, Port Authority of Fiji and the Fiji Mineral Resources Department, supplemented by a generous grant from the Government of New Zealand.

Specific attention was given to climate change issues relating to Small Island Developing States (SIDS) and Alliance of Small Islands States (AOSIS) initiatives during 1999 through participation at regional (Marshall Islands) and international meetings (Norway and Denmark). This included addressing energy issues, mitigation and adaptation options and presentation of the environmental vulnerability index as it related to small island developing states..

Environmental Science Program

Coastal

Management of coastal areas is clearly of considerable concern for the region. In many islands land is an extremely valuable and scarce commodity, yet development of coastal structures and modification of the coastal environment without proper knowledge of how these alterations will affect the area, has clearly resulted in erosion and general degradation of the coastline.

At a more fundamental level, it appears that many island administrations and populations do not have a scientific understanding of the dynamic processes that build and sustain their islands. A relatively small investment in training and education would allow for this information to be freely available and used in the planning process, thus alleviating much of the problem. Fundamentally, the SOPAC Coastal Unit activities are designed to address this need.

In February of 1999 SOPAC's took delivery of its new state-of-the-art shallow-water multibeam mapping system and following its commissioning trials was used in Fiji, in Vanuatu and in New Caledonia (twice).

A new project (supplement to Coasts of Pacific) began during the year to fill a regional data gap in available technical information (at the country level) on criteria for monitoring and evaluating beach erosion and development of management strategies in all member countries. The information will be published by SOPAC and material will be extracted to prepare public awareness brochures for community awareness, to facilitate involving women in coastal monitoring, and as a contribution to addressing the gender imbalance in the geosciences.

Monitoring of ocean and lagoon physical and chemical parameters is an important key to promoting successful maricultural enterprises in the lagoons of atoll countries. SOPAC continues to use numerical modelling techniques for circulation studies of whole lagoons coupled with an interactive database to support data collection, reduction display, analysis and archiving of CTD data and the deployment of long term temperature loggers. Equipment upgrades continued to support the field work and data acquisition with the addition of a second CTD probe complete with dissolved oxygen and turbidity sensors. For real time DGPS an upgrade to a UHF radio link for differential corrections from the reference station was completed.

The mechanical workshop staff at the Secretariat continued the ongoing responsibility of maintaining the field support equipment, with the preparation and assistance in over a dozen field surveys in Cooks, Fiji Islands, Kiribati, FSM, Vanuatu and New Caledonia, Samoa, Solomons and Tonga.

During the course of the year, SOPAC represented the region at a number of international fora such as the UNFCCC Experts Meeting on Coastal Adaptation Technologies, where technical papers on Pacific coastal issues were presented, in Bonn, Germany.

Hazard Assessment

During the year, the main focus for the Hazard Assessment Unit remained the Pacific Cities project. This project is in the process of assessing the impacts of all hazards including earthquakes, tsunamis, landslides, volcanoes, storm surges and cyclones, sea-level rise, erosion, subsidence, settlement, liquefaction and pollution in the larger cities of the Pacific. These hazards, and the attendant risks affecting the major development areas, are addressed through a series of work tasks which include multi-hazard studies, earthquake microzoning, community asset surveys, tsunami modelling studies, and the analysis of risk in various hazard scenarios. The key to these studies is the accumulation of all pertinent data on a single geographical information systems (GIS) database for each study area, and the utilisation of the capabilities of GIS to analyse risk, based on various scenarios.

Pacific Cities will quantitatively assess the risk to people and property from all hazards in selected, vulnerable major cities of the Pacific. Eight cities are being addressed initially with varying degrees of progress being made in each of the cities: Suva, Nadi-Lautoka (Fiji Islands), Lae (Papua New Guinea), Apia (Samoa), Honiara (Solomon Islands), Nuku'alofa (Tonga), Port Vila, and Luganville (Vanuatu).

Although much of the work this year was carried out in Suva, Honiara, Port Vila and Nuku'alofa, the first phases of the project were also initiated in Lae and Nadi-Lautoka. The year was also marked by substantial progress in Apia. A concerted effort in August-September by counterpart and HAU staff in Apia saw the gathering of much of the existing data, a detailed survey of community buildings and assets largely completed, and an earthquake microzoning survey completed and analysed.

The Pacific Cities project also co-ordinates related sub-projects, collecting data from different sources and projects and entering it onto the common GIS database. The project has strong connections with the AGSO Australian Cities Project based in Brisbane and Canberra, and through collaboration and training, takes advantage of methodologies and standards being generated by the Australian project.

There was a continued emphasis placed on a close collaboration between Pacific Cities and the Australian Cities Project this year, including a number of professional interchanges through the year. This collaboration has resulted in revisions of risk standards, various publications, a wider net of contacts and opportunities, and, invitations and funding to visit two institutes undertaking parallel studies in Japan, the geological survey of Japan and the Asian Disaster Reduction Center.

A new, second-phase, Pacific Cities II project, was initiated this year in order to place more emphasis on in-country capacity building for community risk analysis

This year marked the official closure of the Geophysical Institute of Israel-USAID project 'Seismic Microzoning in Capital Cities in the South Pacific'. The results of the project were presented to a wide cross-section of interested communities in Suva, Nuku'alofa and Apia, and reported on to the international community at the Australian Disaster Conference in Canberra.



JAMSTEC co-chief scientist for the Sissano offshore surveys in Papua New Guinea, Takeshi Matsumoto. Deep gratitude for the swift response to the SOPAC request for post-tsunami surveys is owed to JAMSTEC.

Local staff members of HAU were trained at the Australian Geological Survey Organisation (AGSO) Cities Project, in the production of video simulations and other qualitative risk-demonstrations tools for non-scientific audiences.

Earthquake Microzonation/Surveys of Community Assets

In the short term, a prime objective of the project is to acquire an orthophoto base and digital terrain model (DTM) for the GIS database for each city. The underlay of an orthophoto base as backdrop gives the advantage of moving the GIS into the realm of many more users, providing it with far more universal applications. As well as enabling a display of cities in three-dimensions, an accurate and detailed DTM is essential as a numerical base for modelling and quantitative analysis of the effects of tsunami, storm surge, sea-level rise and cyclonic winds.

Tsunami and Storm Surge and Pollution Modelling

The ultimate aim for Pacific Cities is the quantification of risk using the GIS database built up from all the preceding inputs, before it is then utilised in informing Governments and educating the public about the risks facing their communities from natural and man-made hazards. This process is a continuous one, and risk assessment tasks are ongoing and form the over-riding co-ordination on all hazard projects carried out by SOPAC. A wide variety of scenarios and issues have been assessed for Suva and Port Vila where the database development is most advanced.

The report 'An Information Infrastructure for Disaster Management in Pacific Island Countries' (AGSO Record 1999/35) presents the outcomes of the joint SOPAC-AGSO IDNDR-funded Spatial Data Infrastructure Workshop which followed the 1998 SOPAC Annual Session. The workshop and report are the first attempts to bring together Pacific national disaster managers, GIS managers and national Pacific Cities counterparts in discussions on how to build an holistic framework for disaster information management.

Stage one of the Communities at Risk project began this year without specific funding commitment. The Communities at Risk project complements the Pacific Cities project by providing a regional assessment of risk facing rural coastal communities. Work to date has mainly involved the collation of existing work in the region.



SOPAC's newest member: Nauru

Ocean

A project "Ocean Research Co-ordination for Pacific SIDS" was approved by ROC Taiwan during the year and will see the recruitment of a Marine Affairs Adviser. This will greatly assist the Secretariat in oceans issues in supporting members. Whenever possible and appropriate at the national, regional and international level, the Secretariat continued to promote the need for Pacific GOOS. To further the initiative the Director attended the UNESCO/IOC GOOS Meeting in Paris during June and the opening of the new IOC office in Perth, Australia in mid-August.



USP (Marine Studies) vessel used by the Earth Science and Marine Geology course students for field trips.

SOPAC continued its collaboration with the Japan Marine Science and Technology Center (JAMSTEC) in the Triangle Trans-Ocean Buoy Network (TRITON) plan in the tropical Pacific warm pool region to better understand basin scale heat transport with emphasis on El Niño/Southern Oscillation (ENSO), that influences global climate variability. The Program involves measuring the surface fluxes, water temperature, and salinity down to 750 m and full meteorological factors vital to study the water mass formation process and long-range climate variation on a decadal scale.

SOPAC continued association with the joint IOC/IHO GEBCO series as a reviewer for the Southwest Pacific. SOPAC also continued as an Observer for the Southwest Pacific Hydrographic Commission (SWPHC).

SOPAC continued to monitor and provide coordination support for research cruises in the region and keep member countries informed of planned cruises, provide completed data results produced and coordinate opportunities for participation. Data continued to be requested on behalf of member countries and added to the Secretariat databases. It is imperative that these activities be in compliance with the directives and obligations of the UNCLOS.

The member countries must be appraised and be able to act in response to their rights and obligations under the UNCLOS. Of particular concern, though not limited to, are matters relating to the International Seabed Authority, Marine Scientific Research (MSR), boundary delimitation and provisions such as those under Article 76 (SOPAC Miscellaneous Report 227). SOPAC maintained its collaboration with the FFA Boundary Delimitation Program to fulfil its role, SOPAC continued to seek to develop capacity so as to:

provide specialised assistance to SOPAC member countries in the legal and technical aspects of the delimitation of maritime zones and boundaries and the determination of the outer limits of the continental shelf, including the preparation of appropriate databases and maps, the negotiation of maritime boundaries and preparation of the legal, scientific and technical data concerning the outer limits of the continental shelf and provision for training in aspects of delimitation;

provide specialised legal and technical assistance to SOPAC member countries in the practical implementation of the Law of the Sea Convention on matters within SOPAC's technical area of expertise;

monitor developments in the International Seabed Authority and assist SOPAC member countries to participate effectively in the work of the Authority by disseminating information, analyses, studies and reports and, where appropriate, coordinating regional policy; and

assist member countries to adopt regulations concerning MSR and develop efficient and effective administrative practices for handling requests for consent to conduct MSR by foreign institutions.

National Capacity Development Program

Human Resources Development

The first year of the 3-year Earth Science and Marine Geology Certificate Course cycle began 1 March and ended 28 May. Students from Cook Islands, Fiji Islands, Papua New Guinea, Samoa, Solomon Islands, Tonga, and Tuvalu attended. One participant from Samoa completed the basic course by extension (distance education). HRD staff also provided tutorial time whilst on duty travel to Samoa. Of the 14 students who completed the course, all passed year one examinations.

Thirteen (13) SOPAC Fellowships were awarded between the 1998 and 1999 annual session. The attachments were for periods between one week to one month. Countries benefitting include Cook Islands (1) Fiji Islands (2), FSM (2) Marshall Islands (1), Niue (1), Samoa (1), Solomon Islands (2), Tonga (1), and Tuvalu (2). This number is twelve short of the target of 25 island nationals per year for on-the-job training attachments.

Several regional workshops, in-country seminars or short training courses were organised during the reporting period and are reported on by the work program unit principally concerned.

Several in-country seminars or short training courses were organised during the reporting period and are reported on by the principal Unit concerned.

A follow-up seminar on coastal awareness in support of a national coastal awareness campaign initiated in 1997 was rescheduled for April 2000 in Kiribati. Funds were also secured for the translation and publication of the 'Coasts' booklet for Tuvalu.

Basic and refresher courses in geology (including fieldwork skills), hydrology and hydrogeology were undertaken in September in Samoa. These included computer aided teaching methods.



SOPAC Earth Science and Marine Geology course students with their tutor at the USP Marine Studies Complex.

Two SOPAC staff contributed lectures and laboratory classes for the SC301 Applied Geology Course at the University of the South Pacific. Lectures were also provided to the USP Earth Sciences Summer School, Ocean Resources Management Course and to the new Coastal Zone Management Course. Lectures were provided to SOPAC in-house workshops (geophysics). Training staff also sat on the USP Marine Studies Advisory Board and 'Pacem In Maribus' Conference Organising Committee. A presentation was made at the Disaster Management Unit/USAID's Office for Foreign Disaster Assistance (OFDA) Training Meeting in Nadi, Fiji Islands. Training Coordinator also acted as Chair of the Working Group on 'Science to Serve Humanity' at the UNESCO conference, "Science for the 21st Century" in Sydney, Australia – December 1998.

A distance education program in earth science was implemented with one Solomon Islands student graduating in 1999 and one student from Samoa undertaking the ESMG basic course.

Disaster Management

During 1999, progress was made towards establishing a Disaster Management unit at the SOPAC Secretariat. The UNDP South Pacific Disaster Reduction Programme (SPDRP) Phase II was physically relocated to the Secretariat. Funding for SPDRP which is planned to conclude in 2001, is provided by Australia, New Zealand, United Kingdom and UNDP. SPDRP activities have been carried out or are planned under the following initiatives:

- Assist the development of country specific community disaster reduction strategies

- Assist the development of education & awareness programmes and materials

- Funding of project proposals for community level disaster management activities

- Funding of national community disaster reduction focal points

- Develop training manual on vulnerability reduction concepts and community responsive workshop methodologies

- Study on gender roles in disaster management

- Community vulnerability analysis pilot projects

- Assist the development of national training policies and programmes

- Develop training manual for damage and needs assessment course and introduce in-country

- Develop training manual for emergency operation centre management course



Damage to Big Bay Santo, Vanuatu during cyclone "Dani", 1999.



Flash flood, western division, Fiji Islands, 1999.

Assist in-country adaptation of training courses

Funding of fellowship training and exchange programme

Incorporate disaster management into institutional training curricula

Establish regional training coordination unit

Developed exercise management course and user guidelines

Develop information and emergency communication infrastructure

Disaster mitigation pilot projects

Implement recommendation of building code manual

Study in traditional disaster management systems Follow-up activity to the 97-98 El Nino Impact Assessment

Regional Coordination

Annual Regional IDNDR Disaster Management Meeting

Implement national response systems

Disaster Relief

UNDAC Refresher Course

PNG Disaster Management Project Design

Production of the UN Gender Video

Project proposal for psycho-social impacts of disasters

Press Kits/Hazardous Times

Report on IDNDR Achievements Amongst the PICs

Implementation of activities was hindered by slow release of funds. In order to overcome this, the SOPAC Council at its 28th annual session in 1999, decided to appoint a head of the Disaster Management Unit. Council also finalised a business plan for regional disaster management in the future together with a project proposal for consideration by donors.

Information Technology

As planned, key tasks were rationalised during 1999 to provide better transparency and ease of reporting. The tasks have been consolidated into three task development areas.

Information Systems

Communications

GIS & Remote Sensing

Information Systems include database development and maintenance and more broadly, data warehousing. The Regional Data Centre holdings are included as well as Law of the Sea Issues.

Communications include wide and local area networking and use of the Internet as the predominant transport mechanism. Internet and Intranets are included as well as Internet Service Provider (ISP) operations.

GIS & Remote Sensing is fundamental to the operations of a geoscience organisation and this task development area is often the final layer of the knowledge management system that is built upon the foundations of information systems with data warehouses and communications infrastructure.

Each task development area has been divided into the three sections; member country support, secretariat support, and training. Task profiles, however, may address one section in one area or several sections in several areas and vary according to the requirements of individual member countries.

Support to Member Countries and the Secretariat in Information System Development

SOPAC is dedicated to the support of all member countries in the development, installation and maintenance of appropriate Information Technology (IT) systems. These systems are essential for improving the effectiveness of the relevant government department by providing access to timely and accurate information. These systems are the building blocks of knowledge management systems. The objective is the provision of relevant and effective IT systems to assist member countries in discharging their obligations under resource management objectives. Country-specific assistance is reported under the country concerned.

The information system is also a foundation for all activities within the Secretariat and provides all staff with access to organisational information via a server-based system where the servers include file and resource sharing, Internet web services, intranet web services and security. SOPAC is a web-centric organisation and continually migrates and reorganises datasets to be accessible through the common interface of web browsers. The objective is to provide ease of access to information through organised datasets using a common interface. Activities included the following.

- Ongoing development of servers with migration of data from mirrored drives to RAID 5 drives for increased data security has been carried out and all servers were Y2K compliant by the end of 1999. Further implementation of 100Base-T networking has been carried out to allow faster access to shared resources to assist with increasing use of large GIS datasets, image backdrops and graphics intensive applications.
- All new desktop computers were ordered with NT4 and all existing Pentium desktops are being migrated to NT4 and this was completed by the end of 1999. All networked desktops were Y2K compliant by the end of the year. All notebook computers employed Win9x due to limited support for portable functionality with NT4.
- A Microsoft SQL Server has been deployed as the corporate database solution and all live datasets were migrated from Microsoft Access by the end of the year.
- A SunSystems financial package software was installed on a dedicated networked server and is fully functional. This provides a corporate multi-currency account-

ing solution that operates on the Microsoft SQL Server platform. A major advantage of SunSystems is compatibility with other regional organisations including Forum Secretariat and SPC. The software and hardware was acquired under AusAID funding.

Updates to anti-virus software and other core utilities were ongoing where particular attention was given to automating the upgrade of anti-virus engines and update of anti-virus definition files to combat the increasing number and variety of viruses. Deployment of anti-virus software has become increasingly important with the exposure to infection through the Internet.

Support to Member Countries and the Secretariat in Communications Development

The world-wide acceptance of the Internet as the communications transport mechanism and the introduction of Internet services throughout the majority of member countries had provided the avenue for participation in the global knowledge economy. The objective of SOPAC's support to countries in communications development is to ensure that all member countries have Internet access and that the government sectors responsible for resource management are connected to their national provider.

During the year the following activities were undertaken at the Secretariat:

Ongoing maintenance and development of Internet web site for dissemination of information including mission statement, geoscience databases, publications and reports (virtual library), news and weather, marketing of publications and data, links to other sites including web hosting for others in geosciences.



Ongoing development of intranet web site for dissemination of corporate data that is not in the public domain.

- Expansion of remote access facilities to allow staff and associates to access corporate data and exchange mail from remote locations, nationally, regionally and internationally through secure links.

Ongoing development of a virtual private network that allowed the Disaster Management Unit to operate remotely from the Secretariat headquarters and access corporate data and full Internet and intranet services. This unit has now relocated to headquarters and is fully integrated into SOPACNet.



Support to Member Countries and the Secretariat in GIS and Remote Sensing Development

SOPAC is dedicated to supporting member countries in the use of GIS and Remote Sensing technology; and supporting in-country technical staff involved in the development of GIS-related work. The objective is the applied use of this technology to provide improved management of the resources in a sustainable manner through the development of knowledge management systems.

SOPAC as the recognised lead organisation in GIS and Remote Sensing employs these technologies within the broad range of technical programs and respective units. The Information Technology Unit has been tasked with coordinating these activities within the Secretariat.

Support to member countries in the use of GIS Remote Sensing technology requires retrieval and development of utilities to meet the need of the professional in the Secretariat as well as the professional in-country. The development of these utilities is an ongoing task and these are provided to member countries either during in-country visits or during fellowship attachments. These utilities are included in the SOPAC Data CD that is distributed to all member countries at the annual session. Country-specific activities are reported on under the individual countries. Activities included the following:

- Ongoing definition of regional standards where MapInfo and associated tools have been selected for mid-range GIS solutions for all member countries. Ongoing review of other options to meet specific needs of individual countries.

Ongoing participation in the Fiji GIS and Remote Sensing User Group that meets every month where these meetings serve as a technical forum for these issues within Fiji Islands and support to other member countries in the establishment of national user groups, using the Fiji group as a model.

Participation in the PCGIAP (Permanent Committee on GIS and Remote Sensing for Asia and the Pacific) meeting where there was participation by many member countries. At this meeting, the Pacific Group was founded with SOPAC proposed as the secretariat. SOPAC Governing Council approved this initiative at its 28th Session in 1999.



Above and across, images from World Water Day (WWD) 99 art competition. WWD activities were generously supported by the UK Government.

Ongoing maintenance of the GIS-PacNet mailing list used for exchange of GIS and Remote Sensing information throughout all member countries with e-mail access. There were approximately 53 subscribers as at July 1999.

Editing, production and distribution of the Regional GIS and Remote Sensing newsletter jointly with USP continued. The newsletter is sent to subscribers in all member countries. There are approximately 250 subscribers.

At the 1999 Council Meeting a GIS policy was endorsed. The objective is coordinated development of scalable and transferable systems that assist all SOPAC programs in effectively carrying out their respective tasks.

Publications and Library

A total of about 80 internally-produced reports (refer List of Publications appended) passed through the SOPAC publishing system of which more than a third were formal technical reports containing new, analysed and processed data from recent SOPAC field surveys. The Proceedings of the 28th SOPAC Session was published and distributed in December 1999.



Technical summaries and promotional material published included the 1998 Annual Report Summary, two issues of SOPAC projects and two issues of SOPAC News. The Activities Profiles introduced last year; along with the 1999-2001 Strategic Plan were both finalised. Two issues of the Pacific GIS & Remote Sensing Newsletter were produced in collaboration with the SOPAC Information Technology Unit and USP's GIS unit.

First drafts of a new series of country-by-country promotional profiles were developed and introduced to the SOPAC Council at the SOPAC Annual Session in October. These country profiles attempt to provide snapshots of how SOPAC's very specific role fits into the broader framework of priorities in national and regional development.



This year's World Water Day involved coordination and judging entries for school essay and poster competitions under the theme: "Everybody Lives Downstream". Organising the schools competition was a first for the SOPAC Secretariat and was an enormous success. A special-issue of SOPAC Projects was produced for this activity (SOPAC Projects 12, June 1999). Artwork received from the drawing and colouring competitions was used in a promotional calendar.

Work with the network, Pacific Woman & Her Environment: A Better Life for Communities through Science and Technology (ECOWOMAN), continued with participation at Steering Committee meetings by the Publications Coordinator; attendance at the World Science Congress in Budapest; and as an advisory to the ECOWOMAN network on publishing; information technology; and SOPAC's role as the premier geoscientific organisation in the region.



Winners of the World Water Day 1999 Essay Competition, with British Embassy officials at the SOPAC Secretariat for the prize-giving ceremony.

Continued increase in the requests for reports and publication via the Internet has provided the impetus for entering the realm of web publishing, at least in part. A preliminary survey of SOPAC News readership has been completed and from the year 2000, SOPAC News will be available to subscribers both as paper and electronic copy. This exercise was last carried out in 1990. The Internet access by most professional readers slashed our mailing list down by 80%, but more than doubled readership.

Funding was secured from the UK Department for International Development (DFID) for a Tuvaluan translation of the perennial "Coasts of Pacific Islands" and an extension of the coastal awareness work on Kiribati. Work on special promotional material for public awareness campaigns on areas within SOPAC's mandate are ongoing. Work is also ongoing on major special-issue scientific bulletins that update the region's pool of geoscientific knowledge; currently two, the first on volcanic hazards and the second on mineral exploration technology.

Library Services continued to be maintained by inter-library loan, reference and reader services, for Secretariat staff and on request from member countries. Library Services are on-going, and the same services were maintained during 1999 by the Publications Assistant/Librarian.

Maintaining the SOPAC Bibliographic Database is an ongoing service, and through the Pacific Islands Marine Resources Information System (PIMRIS), the Publications Assistant/Librarian continued to assist the region with marine resources information, particularly in the geosciences.

Monitoring of library usage and internet queries for SOPAC information again showed 100% increase in internet usage for accessing information over last year; and for the same period, a 20% increase in library usage by outsiders was recorded.

Member Country Projects

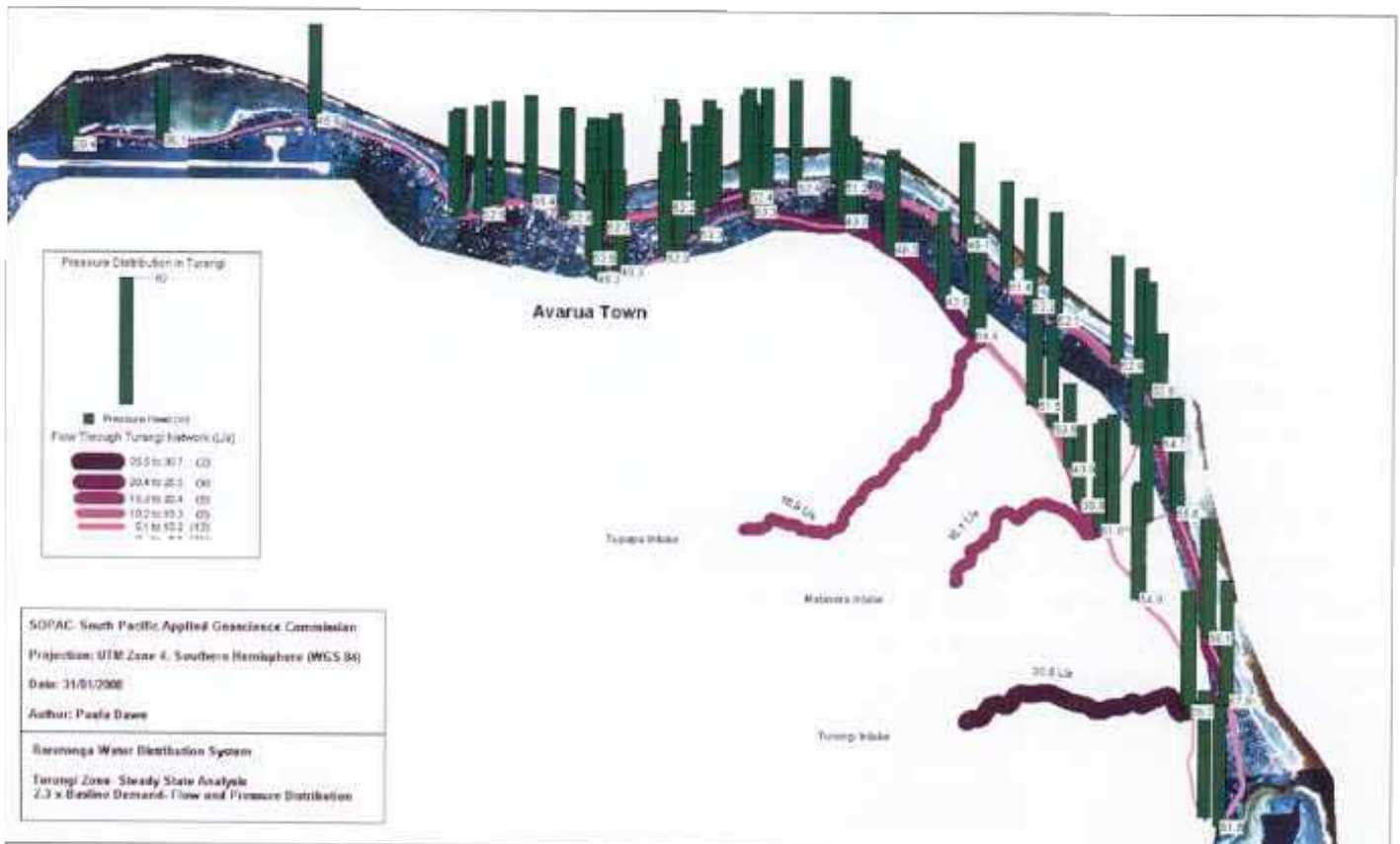
Cook Islands

A watching brief was kept on the technology, market and the price of cobalt, nickel and copper for the assessment of manganese nodule potential. An estimated reserve of 7474 million tons containing 32 541 000 tons of cobalt, 24 422 000 tons of nickel and 14 057 000 tons of copper in nodules with a cut-off grade of greater than 5 kg/m² in an area of 652 533 km² occur in the Cook Islands EEZ. Currently, technology is not fully developed to enable the economic mining of these nodules.

With the recent demand and high price of cobalt, the possibility of mining nodules has become a strong consideration for the Cook Islands Government. A request to assist in the preparation of a short-, medium- and long-term strategic plan for development of the resource has been made by the Cook Islands Government. The task was postponed at the request Dr Jim Gosselin of the Cook Islands Government.

A draft national energy policy for the Cook Islands was completed.

The Cook Islands have been visited twice in conjunction with the demand management project and baseline data collected on their water supply and unaccounted-for water. A visit to Rarotonga was undertaken to collect background information on their water supply system. Ministry of Works, Energy and Physical Planning (MOWEPP) staff were introduced to the hydraulic modelling software. A model was prepared and presented to the Ministry. SOPAC Water Resources Unit staff also installed a GPS base station at the Ministry and provided training on GPS data collection; also repairing equipment owned by the Cook Islands.



Coastal mapping was completed in Rarotonga and Aitutaki to supplement earlier work done by SOPAC. This included the comparison of digital aerial photography of the mapped area taken between 1998 and 1992 that documented shoreline change, morphology, sand-sheet migration and other changes on reef flats. Sediment samples were also collected and analysed.

The expansion of black pearl aquaculture to Penrhyn Lagoon has led to the need for better understanding of lagoon circulation and ecology to determine capacity and management needs for which the bathymetry is the priority requirement. The remoteness of Penrhyn however has deferred the survey implementation.

A GIS was developed to assist in the management of pearl farms during a two-week attachment by a staff member from the Ministry of Marine Resources.

Advice was provided to several Departments by SOPAC IT staff on network development.



Collapse of the west end of the coastal protection units in front of the Rarotongan Hotel, Cook Islands, under scouring and undermining of longshore currents. Picture looking east.

Federated States of Micronesia

Coastal erosion problems exist in various states of the Federated States of Micronesia (FSM). A survey of twenty-one islands Pingelap, Mokil, Sapwuafik and Nukuoro in Pohnpei State; Satawan, Losap, Pollap, Polowat and Alet in Chuuk State and Lamotrek, Elato, Fechaulap, an un-named island, Ifalik, Woleai, Tagaulap, Falalis, Utagal, Saliap, Euaripik and Mogmog in Yap State was carried out during the reporting period. The results were presented to the FSM Congress and National Government on 30 July 1999 as a technical paper on Coastal Erosion and Management in Federated States of Micronesia.

A coastal aggregate assessment study which is being conducted for the island of Pohnpei included a bibliographic search and literature review of information on the geological and geotechnical properties of soils and rocks geology in Pohnpei, Federated States of Micronesia. Further field work and mineralogical and geotechnical analysis of rock samples was completed and suitable quarry rock identified.

Seven FSM island nationals from Marine Resources Department, Pohnpei and Chuuk States; College of Micronesia (COM), Pohnpei and two were from the Environmental Protection Agency (EPA), Yap State, FSM were provided on-site field technical training in coastal erosion assessment, coastal geology and shoreline and environmental techniques.

Federated States of Micronesia was assisted in preparing a draft national energy policy statement and in convening an Energy Policy Summit in conjunction with the National Government, with participation from all the States.

Pohnpei was also selected as the venue to host a sub-regional energy database workshop with participation from the four FSM States, Nauru, Marshall Islands

SOPAC has initiated the development of incountry computer mapping technique and has shown that the sustainability of these projects can only be achieved if proper training is supplied in country or through attachments at the Secretariat. The objectives include the training of users from the various government departments and to show the benefit of the use of GIS to high-level decision making. The following activities were carried out:

A one-week workshop was conducted by one SOPAC staff to introduce GIS as a tool for asset and resource management.

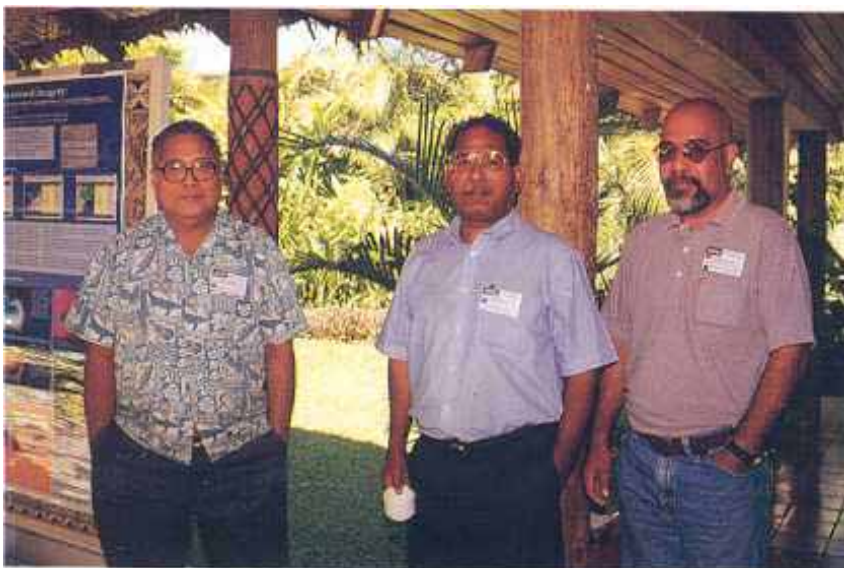
GIS equipment was procured for Pohnpei Environmental Protection Agency and a GIS-based Information system was developed and deployed during a three-week visit during which time a one-week workshop was conducted to introduce GIS as a tool for asset and resource management. This was the first of two phases and a second phase is scheduled for implementation during the first quarter of 2000. In addition, a proposal was prepared for the first phase of a two-phase GIS-based asset and resource management project for the Kosrae Environment Protection Agency. All these GIS-based projects in Federated States of Micronesia have been funded through Australian government support.

Assistance was also given to the Embassy, Suva, with maintenance and upgrade of their information System.

Fiji Islands

A geophysical study consisting of electromagnetic and seismic surveys was conducted in December 1998 in the Nasivi Delta. The geophysical study identified potential targets for follow-up drilling. In November of 1999, a drilling program was undertaken. Eight drill holes to depths of up to 50 m were drilled. The samples are currently being analysed for gold. The Nasivi River delta holds good potential for placer gold due its proximity to the Emperor Gold Mine. Previous work by exploration companies have also confirmed gold values that required follow-up.

Recently there has been concern by landowners on the effect of mining at Mt Kasi on the Yanawai River and coastal environment. Reported fish kills in the river are alleged to have been the result of pollution from the mine. There is little baseline information to support these allegations. In 1998, SOPAC with MRD started a baseline study to determine water quality, current circulation patterns, bathymetry, and sub-bottom structure.



Representatives of the Federated States of Micronesia at the SOPAC 28th Session.

Due to funding rearrangements, the study has been postponed for third quarter of 2000.

A fair and comprehensive policy for assessing the compensation due to landowners through costs incurred in mineral development can reduce friction between stakeholders and help achieve sustainable development in the mining sector. SOPAC continued working with the Fiji Mineral Resources Department to formulate a working compensation policy that included mechanisms to assess social, environmental and physical costs incurred through mining. This extensive policy review has been completed. Due to the sensitive nature of land issues in Fiji the paper has been submitted to the Fijian Affairs Board who are tabling it in the Great Council of Chiefs. It has been agreed to in principle by the Committee of Permanent Secretaries and is now going for external stakeholder review. A publication is being prepared outlining the compensation policy in Fiji. It is an innovative policy dealing with the strong attachment to land in Fiji and potentially relevant to not only the Pacific but other areas of indigenous land owning elsewhere in the world.

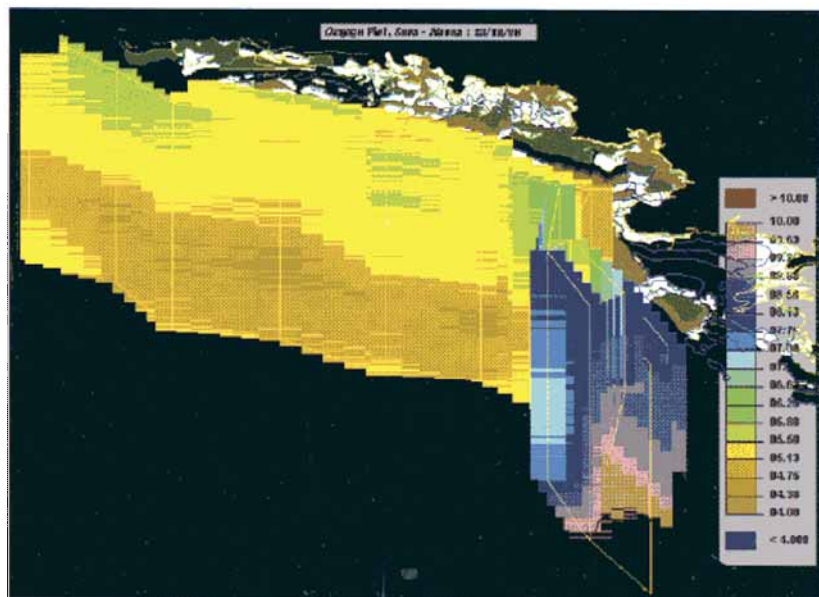
The Tuvalu project was expected to proceed to the feasibility stage this year however due to the low gold price the application for a mining lease has been delayed. Only when the feasibility study and EIA have been completed can a full cost benefit analysis be done.

Fiji has recently been approached to grant two offshore exploration licences in its waters. The present legislation in Fiji does not cover the offshore comprehensively. SOPAC has been chairing a committee with the government to develop an offshore policy. This policy has been completed and is undergoing stakeholder review.

SOPAC participated in the Natadola Cost Benefit Analysis. Natadola Beach has for many years been considered a prime site for tourist development. Natadola Marine Resort has made a proposal to government to develop the location. Plans include four hotels, condominiums, an international standard golf course and a marina. It is expected that the development may result in an additional 12 000 people or more living in the area with government financing certain infrastructure at significant cost. Completed field studies in Natadola included data collection on currents and water-level monitoring, beach profiling and CTD measurements. A hydrodynamic model of the bay was also completed.

Knowledge of Suva Harbour was upgraded this year with survey work carried out using SOPAC's new swath mapping device. The project 'Seismic Zonation of Suva Central City and Simulation of Tsunami Risk in the Harbour', funded by the French Pacific Fund, with the aim of producing 3-D earthquake modelling of Suva peninsula and tsunami modelling in Suva Harbour, continued through 1999.

A two-week field study with a Victoria University student on Namuka Channel sedimentation and the recent carbonate sediments of the Namuka Reef area west of Suva was completed.



Oxygen profile in Laucala Bay (Fiji Islands), a plot out of an interactive graphical ocean data system (IGODS) useful for data analysis and monitoring long-term trends.

A thesis is being prepared on sediments around the area of Nukubuco Reef off Laucala Bay, Viti Levu that is currently being dredged for industrial uses. The work concluded the sediment to be largely formed from coral debris, with contributions from larger foraminifera, molluscs, calcareous algae and echinoids in particular. A simple technique for lowering the MgO content of sediments (important to cement production) was devised, and a geochemical method for calculating the otherwise unknown red algal content of recent sediment was developed.

At the request of the National Trust of Fiji, a geophysical survey was completed around the mouth of the Sigatoka River to support archaeological research into early human settlement in this area. Establishing and planning tourist resort facilities can have an impact on the coast.

Monthly conductivity-temperature surveys between Makuluva and Beqa islands for water-quality monitoring over the three-year period 1997-1999 was archived and reported on to the Fiji Mineral Resources Department.

Assistance was provided to (i) Forestry Department with development of the Forest Export Market System where GIS is an integral component. (ii) National Disaster Management Office through analysis of satellite imagery of areas affected by the 1998 drought; and (iii) Mineral Resources Department with ad hoc GIS development.

Training is essential to maintain skill levels of member-country technical staff responsible for deployment and development of in-country information systems. Training is also provided for Secretariat staff responsible for maintenance of the corporate information system. The objective is to provide adequately trained staff in member countries to ensure that information systems are maintained and developed. Activities in Fiji included the following:

- an integral component of the Forest Export Market System for Department of Forestry was the deployment of a Microsoft BackOffice. Several staff received on-site training in these technologies as well a development using Microsoft Visual Studio Enterprise.

Assistance to Forestry Department with installation of a wide area network with central hub at Management Services Division where this is an integral component of the Forest Export Market System. Assistance to Research Division of Forestry Department with establishment of postoffice to provide all networked staff with individual e-mail accounts.

With the aid of the French Pacific Fund, and in conjunction with A2EP in New Caledonia, aerial photography was obtained for western Suva, which has now been processed into a digital terrain model and orthophoto.



Taveuni volcano workshop participants, Fiji Islands.

It is essential for the Pacific Cities project to eventually reach the stage of incorporating census and population data, and building and community information held by the appropriate Government Departments and City Councils in each city. Progress has been made to this end in Suva where a working relationship has been established with the Suva City Council (SCC) through a French-funded project to build a GIS section for the SCC. The Fiji Bureau of

Statistics agreed to sell SOPAC pertinent information to enable the analysis of demographic issues in Suva.

Assistance was provided to the Fisheries Department with database and network maintenance and development. This was undertaken as a reciprocal arrangement with the Forum Fisheries Agency (FFA).

Ongoing development for Fiji Internet/Intranet Group (FIG) with exploration of alternative technologies such as VSAT (Very Small Aperture Terminal) satellites to provide faster access and more cost-effective service. The exclusive license has been removed in Fiji Islands and other Internet Service Providers can be formed to provide necessary competition to the national telecommunications carrier who enjoyed a monopoly for providing Internet services. It should be noted that several PIC telecommunication companies regard Fiji Islands as a model and any removal in monopolies will result in drop in charges and a resulting benefit to other countries. A major objective of FIG has been the scalable and transferable model that together with experiments with alternative satellite systems offer opportunities to establish Internet services where these are non-existent or unaffordable. FIG, where SOPAC is the gateway partner, currently operates at an international link speed of 19.2 kbps. There are 10 partners with dedicated connections that include European Union, Fiji Institute of Technology, Forum Secretariat, Fiji School of Medicine, Fiji Trade and Investment Board, French Embassy, Mineral Resources Department, SOPAC, SPC, UNDP as well as FAO Aquaculture, Federated States of Micronesia Embassy, Forestry Department, FSP Suva and Marshall Islands Embassy.



Port Authority of Fiji officials and Secretariat staff discuss the use of the SeaBat multibeam system in port development in Fiji. PAF was party to the cost-sharing arrangement between a number of Fijian agencies and the New Zealand government to purchase the shallow-water mapping system.

The Energy Unit has provided training assistance to the Fiji Department of Energy (DOE) in wind resource assessment evaluation and assisted in supporting both technically and financially a DOE Officer completing a Master Degree to evaluate the Nambawalu Hybrid power scheme. Linked with issues on changing climate and the desire of countries to meet their commitment under the Kyoto Protocol, initial assistance was provided to Fiji in the preparation of their National Communication and Greenhouse Gas Inventory. The Energy Unit has also participated and contributed to other climate related meetings convened in Fiji.

Guam

Work on a new technical bulletin and map on the geology and stratigraphy of Central and Southwest Guam: an Eocene/Oligocene volcanic arc with special emphasis on the Alutom Formation was ongoing. This is expected to be ready for peer review by scientists from the University of Guam in the fourth quarter of 2000.

Kiribati

SOPAC provided comments on the pre-feasibility study report on Banaba (Ocean Islands) phosphate extraction. Astro Pacific Corporation Ltd of New Zealand conducted the pre-feasibility study for the Ministry of Natural Resources Development.

An assessment of vulnerability to accelerated sea-level rise first completed by SOPAC for Betio in 1997 was extended to take in the rest of South Tarawa. A three-week site visit to acquire data was completed during the period 26 July to 19 August with assistance from the People's Republic of China.

The atoll islands of Kiribati are made up largely of corals, but there is limited knowledge on the species, abundance and distribution. This project comprised the training of the Fisheries Division's Coral Reef Monitoring team in the AIM'S Reef Monitoring Data Entry System. The training involved a hands-on approach with instruction involving the implementation of the diving survey. Post-fieldwork involved the discussion of field techniques and data entry. Work was completed in Tarawa and Abaiang atolls.

Sanctuary areas for aquaculture projects in Tarawa and Abaiang lagoons require a better understanding of lagoon bathymetry, circulation and ecology to determine capacity and management needs. Field surveys in Abaiang were completed during August. Data collected included bathymetry, water level, currents and salinity. Ten self-logging temperature gauges were deployed for a period of 12 months in both atolls to monitor seasonal variations. Samples collected from the areas of the oceanic reef around the sewer outfalls to examine the impact on the environment using the ostracods are proving to be useful as an indicator of water quality as there pattern of distribution is developed.

A doctoral thesis for studies on carbonate sedimentation and recent influence of human activity on Tarawa was also completed.

Assistance to the Ministry of Natural Resources Development with procurement of equipment to upgrade the file and communications server and provide wide-area networking for information exchange between the several Departments and with links to the National Disaster Management Office.



SOPAC 28th Session witnessed a greater number of women representatives behind national flags. Kiribati will host the SOPAC 29th Session in 2000, in Tarawa.

Assistance was rendered in the upgrading and establishment of a national energy database, the collection, inputting and management of energy sector data. Preliminary work was completed on the initial components of an energy statistics year book.

An evaluation was carried out of the fairly sparse wind energy resource data of Kiritimati (Christmas Island), with the view to establishing a project to further evaluate the wind resource as an

energy generation option for the island. Assistance was provided to Kiribati with the development of a project proposal for this resource assessment.

Technical information was provided on biogas and biomass production, both of which are being considered on Tarawa.

Marshall Islands

Assistance with developing a groundwater protection and monitoring program on Majuro was provided, together with the design and development of a water quality database for Majuro Atoll was provided to the RMI Environmental Protection Authority.

Coastal geology mapping recently completed for Majuro Atoll by SOPAC is currently only available in hard copy. Compilation of this data into a Mapinfo format along with other existing coastal information is underway for more efficient management and thematic mapping. A major requirement for this work is to put in place ground control in order to bring the data into an updated GIS geodetic reference system.

As knowledge of the regional distribution of the foraminifera increases, it is becoming apparent that the types of coastal sediment in the region are related to the biogeography of the foraminiferal species rather than to coral or calcareous algae. Laboratory work on sediments from Majuro, Marshall Islands is underway at Victoria University in Wellington.

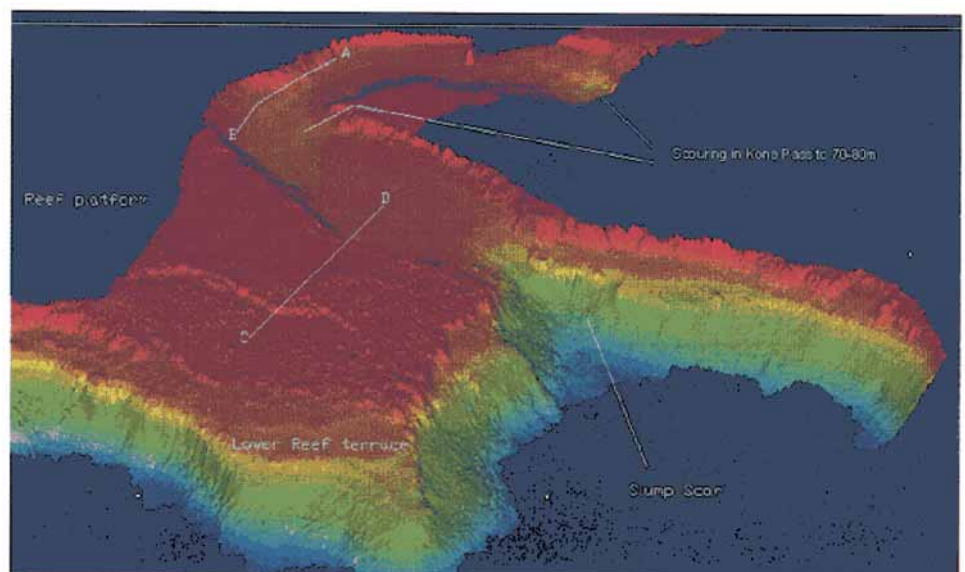
The Marshall Islands was assisted in preparing a draft rural electrification policy and implementation guidelines.

Assistance was also provided in re-establishing the energy database with the Marshall Energy Company (MEC) and providing initial training in database management. Following this initial training the Marshall Islands also participated in the sub-regional database training workshop convened in Pohnpei, FSM.

Assistance was provided to the Suva Embassy with maintenance and upgrade of their information system.

Nauru

The Energy Unit provided advice on general energy issues, energy policy and the need to review energy pricing policies. Training was provided in conducting and evaluating the results of energy audits and preparing recommendations. This activity has assisted in the identification of suitable energy efficiency and conservation projects that would help Nauru to reduce its current levels of energy consumption. The pro-



A rendered digital seabed elevation image of a passage in a barrier reef in New Caledonia.

posed opportunities include the introduction of timers for air conditioners and the introduction of LPG stoves for cooking to replace electric ranges in the domestic sector and associated energy education programmes.

Linked with climate change issues and the desire of countries to meet their commitment under the Kyoto Protocol, assistance was provided to Nauru in preparing their first National Communication and Greenhouse Gas Inventory.

Nauru also participated in a sub-regional energy database workshop held in Pohnpei (FSM).

Assistance was provided by IT staff in the recovery of a national GIS during a one-week visit to develop tasks for establishing GIS facilities.



The representative of Nauru handing over Nauru's formal accession to the SOPAC Constitution to the Fiji representative and the current SOPAC Chair, the New Zealand representative.

New Caledonia

Two lagoon resources field surveys were completed in Noumea and Koniambo. The Noumea survey used continuous seismic-reflection techniques and swath mapping to make a preliminary assessment of the non-living resources of the lagoon areas of New Caledonia. The Koniambo survey used the multibeam mapper to delineate

bathymetry and morphology of the forereef to select a suitable site for a submarine tailings outfall. Data collected included multibeam and single channel seismic data.

Niue

Following the completion of a feasibility study for the development of wind energy in Niue opportunities continue to be identified for the funding of this installation as a grid connected demonstration wind turbine for the region.

Niue's solar waster pumping project funded through SOPAC's small energy project programme remains to be completed.

A draft mineral policy was developed for Niue. Recently there have been indications that some raised atolls may have mineral potential such as gold and copper beneath the limestone cover. In Niue, a prospecting license was issued to a mining company to prospect for minerals some years ago.

Niue, as a beneficiary for the NZODA small-scale wastewater projects was assessed on their current waste disposal practices and sanitation projects. Assistance towards developing a GIS for their water supply system was initiated. These are both being carried out in close collaboration with Public Works Department.

Coastal morphology mapping for Niue is currently only available in hard copy. Compilation of this data into a MapInfo format along with other existing coastal information is required for coastal management. This work is currently ongoing.

A two-week GIS and Remote Sensing Workshop was conducted in Niue by two SOPAC staff to enhance asset management, land-use planning, hazard assessment and coastal zone management.

Papua New Guinea

The Offshore Mineral Policy Workshop for Papua New Guinea (PNG) was completed in February. The workshop was hosted by the PNG Department of Mineral Resources and coordinated by SOPAC and sponsored by MMAJ and the Forum Secretariat. SOPAC Miscellaneous Report 323 documents the proceedings of the workshop.

The 17th July 1998 tsunami in the Aitape-Sissano area on the north coast of Papua New Guinea was particularly devastating. Wave heights of 10 meters were experienced along a 25-kilometre stretch of coastline with maximum heights of 15 meters. Three villages were wiped out, four more badly damaged and over 2200 people died. The greatest documented destruction was concentrated along the ten-kilometre long sand spit that separates the Sissano Lagoon from the sea.

Two major offshore marine surveys suggest that the tsunami was caused by a sediment slump located 25 km offshore. The slump was probably the result of seabed shaking from an earthquake. This conclusion is based upon: i) a new offshore bathymetry, ii) ROV dive investigations, iii) the time delay between the source earthquake and when the tsunami struck, iv) computer simulation models and v) earthquake aftershock distribution. Not only was a sediment slump responsible for the tsunami, but the magnitude and wave-height distribution of the tsunami along the coast was the result of focusing by local seabed morphology.

The two offshore surveys were carried out in January and February by the Japan Marine Science and Technology Center (JAMSTEC) and SOPAC using the JAMSTEC research vessels *Kairai* and *Natsushima*. For the first time, a major offshore study was carried out very soon after a tsunami event and the tsunami is the first to be comprehensively investigated by onland study, offshore seabed imaging, geological interpretation and computer simulation. Although in the past there has been extensive investigation into trans-oceanic tsunami, originating from far away, these results show that low-magnitude earthquakes (~7) from nearby sources may result in massively destructive events, especially if the earthquake results in a sediment slump.

Samoa

Coastal morphological mapping of the northeast coast of Savai'i was completed in the latter half of the year with assistance from marine geological personnel from the Korea Institute of Geology, Mining & Materials (KIGAM), ably assisted by Apia Observatory staff. KIGAM continues to provide much needed support to the coastal program on a yearly basis.

Assistance was provided for the development and application of national databases for the long-term storage of water resources and related information by building the capabilities within member countries and providing technical support and backup facilities.

A manual on groundwater assessment and data processing has been developed.

IT training is essential to maintaining skill levels of member country technical staff responsible for deployment and development of in-country information systems. Activities included the following:

A two-week training attachment was provided for the System Administrator from the Meteorology Division in Microsoft NT Server installation and administration and Microsoft BackOffice family installation and administration as well as physical network operations.

Establishment of postoffice in Meteorology Division to provide all networked staff with individual e-mail accounts.

Efforts were made this year in Apia to produce digital databases of all geological and geotechnical drill hole information for the city.

The year was marked by substantial progress in the Apia Pacific Cities project. A concerted effort in August-September by the Samoan counterpart and HAU staff in Apia saw the gathering of much of the existing data; a detailed survey of community buildings and assets largely completed; and an earthquake microzoning survey completed and analysed.

Efforts were made this year in Apia to produce digital databases of all geological and geotechnical drill hole information for the city.

Basic and refresher courses in geology (including fieldwork skills), hydrology and hydrogeology were undertaken in September. These included computer-aided teaching methods.

Assistance was provided to the Department of Lands, Survey and Environment with their Information System and to the Meteorology Division with a review, proposal and procurement of equipment required for upgrading their wide and local area network.

Solomon Islands

SOPAC continued to advise on issues related to mine development at Gold Ridge. Ross Mining Company during the year announced that further gold deposits were discovered and expected gold production to increase from 100 000 oz to 300 000 oz per year.

With the difficulty encountered amongst the various ministries in the Solomon Islands during the negotiations for Gold Ridge, a comprehensive Mineral Master Plan was identified as essential for future mineral development in the country. A proposal for the Master Plan was written for funding identification.

Assistance with the development of a national water policy and legislation was provided. The existing draft water document prepared by UNDP in 1987 needed to be reviewed and updated.



Niue: a single uplifted coral atoll.

Compilation of an inventory and preliminary environmental assessment of contamination risk to Iron Bottom Sound from WW II sunken vessels and aircraft was completed and submitted via UNDP to UNOPS who partly funded this study. A follow-up plan for Phase II was prepared and submitted which will be conducted in the same area, and will entail a more detailed assessment of contamination risk in the nearshore coastal areas of Iron Bottom Sound, between 0-100 m deep. A shallow-water swath mapping survey for delineation of the shallower wrecks, compilation of the nearshore living and non-living resources, for evaluating possible environmental impact in the area are planned for this follow-up study.

The final stage in the development of the national Power Utility GIS for the Solomon Islands was completed during a two-week visit under the Pacific Regional Energy Program.

A workshop to enhance community response to volcanic hazards was held at Savo Island in November.



The women's discussion group, at the Savo volcano public awareness workshop, run by the Disaster Management Unit for the Solomon Islands.

Tonga

A final report on sand and aggregate resources at Vava'u was received from Korean geologists from KIGAM. Further field assessments to complete this project was rescheduled to 2000.

A groundwater assessment was carried out on the islands Lifuka, O'ua and Lofanga by SOPAC staff together with their Tongan counterparts. The training exercise involved field work and data analysis on Lifuka, O'ua and Lofanga followed by further analysis and interpretation in Nuku'alofa.

Tonga has been visited by Water Resources Unit staff and a hydraulic model for the Nuku'alofa water distribution system was produced in close cooperation with Tonga Water Board (TWB) staff. A study on best methods to detect PVC pipes in a water distribution system was also carried out and introduced to TWB staff. TWB is currently using SOPAC equipment for that purpose. A Tonga Water Board engineer also underwent training at the Secretariat in hydraulic network analysis.

The Energy Unit installed a modified energy database into the Energy Planning Unit and provided training in data collection, data inputting and management.

Tuvalu

Research continued into the distribution of foraminifera, the importance of the larger foraminifera to sedimentary processes in the coastal zone, and the composition and origin of carbonate sediments in general. Laboratory work carried out at Victoria University on sediments from Fongafale Atoll, Tuvalu has been completed and this work is being prepared for publication. This may have important implications for resource management and coastal zone planning in the region as a whole.

IT technician training is essential for all levels of communications, and maintaining information systems. The following activities were carried out:

A two-week training attachment was provided for two technical staff to assist in the establishment of a national ISP as well as a government LAN/WAN.

A two-week training attachment was also provided for the Network Administrator from the Government Computer Centre in Microsoft Windows NT deployment.

- Assistance was provided to the Department of Lands and Survey in upgrading and networking their Information System.

A two-week Tuvalu national GIS and Remote Sensing Workshop was conducted by two SOPAC staff together with assistance in implementing GIS-based projects. A three-week training attachment was provided for one staff from the Department of Lands and Survey in GIS operations and digitising techniques.

Funds for a translation into the vernacular and a Tuvalu version of the SOPAC "Coasts" booklet was secured from the UK Government. This activity was rescheduled to the second quarter of 2000.

Vanuatu

With supervisory and training assistance from SOPAC, the Department of Geology, Mines and Water Resources (DGMWR) recently completed a mobile metal ion geochemical survey over an aeromagnetic anomaly on Eastern Santo. The results of the survey identified three target areas that warrant follow-up work. A ground magnetometer survey was recommended prior to any expensive program such as drilling. Vanuatu again requested supervisory and training assistance from SOPAC for such a survey. This project is currently on hold due to staff shortage in the Department of Geology, Mines and Water Resources in Vanuatu.

Due to the lack of information regarding the process of exploration, landowners have often interfered negatively with exploration activities of mining companies e.g. accused mining companies of stealing gold when taking samples for analysis. In-country seminars to discuss with the community the rights of landowners and the

process of exploration were conducted in June in various villages in Vanuatu. Training was also provided to a technical officer at the DGMWR who is now able to conduct these seminars on his own.

Currently in Vanuatu aggregate for construction (roads and buildings) is derived from limestone outcrops. Although several of the islands contain basaltic material, the islands have not been assessed for quarrying potential. Approximately 100 kg of basaltic samples were sent from Santo for aggregate testing.

Vanuatu has been visited in conjunction with the demand management



Location map of Iron Bottom Sound, site of a recent contamination risk assessment study from WWII armoury in the Solomon Islands. The study was funded by UNDP.

project and baseline data collected on their water supply and unaccounted-for water in rural areas with the Rural Water Supply Section.

WRU provided further assistance to the Department of Geology, Mines and Water Resources with regards to the AusAID-funded Hydrological Baseline Studies. The work comprised assistance with the development of office procedures for the hydrological section and field work on Santo.

The aerial photography for the DTM of Port Vila has been flown. Control points have been surveyed and preparation of the DTM and orthophoto completed.

A basic hydrodynamic model has been produced by SOPAC for tsunami, storm surge and pollution modelling in Port Vila Harbour and Mele Bay.

Ni-Vanuatu Toney Tevi graduated with a BSc. from USP after being supported with a SOPAC/CSPOD Scholarship.



Reginald Pal, Environmental Scientist with the SOPAC EVI Group, briefing Kiribati officials in Tarawa on the status of EVI work currently underway at the Secretariat.

Management and Corporate Services

Finance and Administration

The work of the Finance and Administration Unit throughout the year focused on ensuring the following services were provided:

- Professional financial Services
- Advice to management on financial matters
- Timely management, financial and audit reports
- Assistance in the preparation of Work Program and Budget
- Professional personnel services
- Administration, office and property support services
- Design, implement and maintain operational systems
- Development and maintenance of project database
- Implementation of Finance package funded by Australia
- Timely preparation and reporting to donors and support agencies

Technical Work Program Management

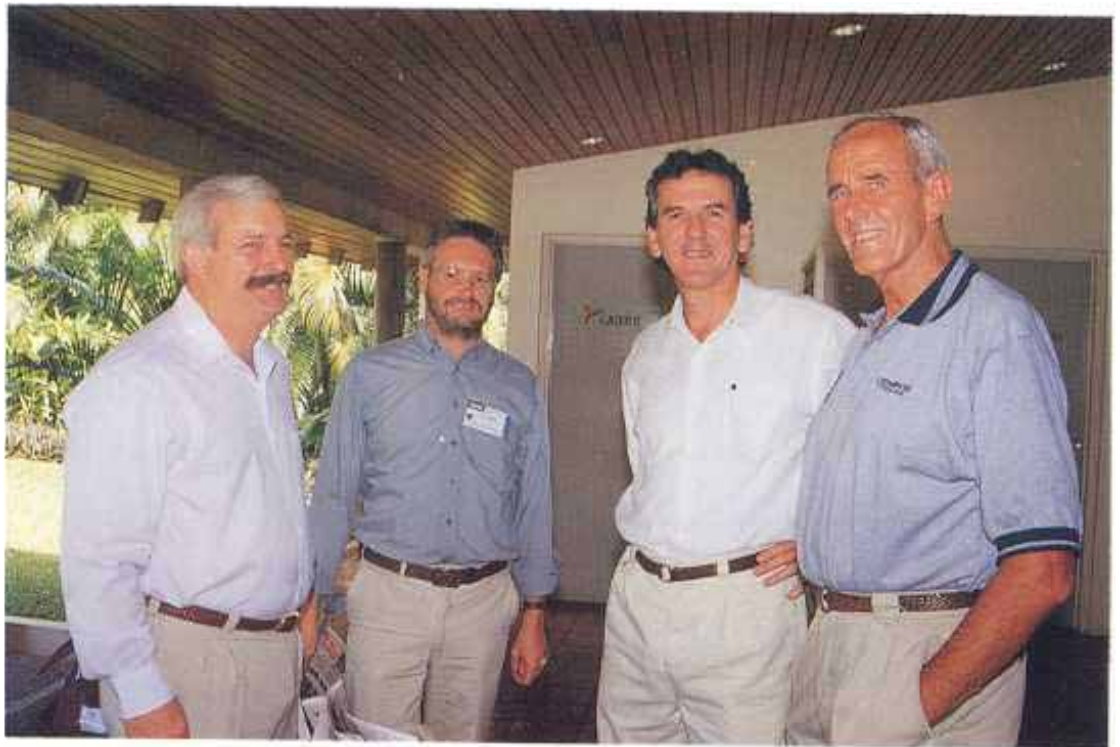
Environmental Vulnerability Index (EVI) Study

In 1998 with funding from the New Zealand government, a SOPAC study team was put together to undertake the Environmental Vulnerability project. In February 1999 the team produced its first report entitled Environmental Vulnerability Index (EVI) to summarise national environmental vulnerability profiles (SOPAC Technical Report 275). The report was widely circulated throughout SOPAC member countries and internationally through the establishment of a special discussion web-site to facilitate extensive access and to encourage discussions on the methodology for determining environmental vulnerability.

With continued funding from the New Zealand government Phase II of the EVI project was undertaken. The primary goal of this next phase was to obtain extensive international peer review on the SOPAC environmental vulnerability study team's proposed methodology for determining environmental vulnerability. This was facilitated through the convening of an International Expert Group Meeting on Environmental Vulnerability in Pacific Harbour, Fiji from the 7-10 September 1999. This meeting was successful in obtaining international expert peer-review and direction for the future development and operationalising of the EVI. This culminated in a Report on the Environmental Vulnerability Index (EVI) Think Tank, 7-10 September 1999, Pacific Harbour, Fiji (SOPAC Technical Report 299).

An important part of this phase has been the identification, collection and collation of environmental vulnerability data from several countries including Fiji, Samoa, Tuvalu and Vanuatu. This involved country visits and follow-up work in assisting countries to assemble environmental vulnerability data profiles for each country. This important raw country data has provided the basis for further testing of the EVI and its potential use as a tool for determining environmental vulnerability of countries. Environmental vulnerability data from Australia was also to be collected in this phase of the project but this is still to be completed. Australia although willing to participate through the provision of data for the project has requested that the EVI undergo further testing and refinement before they intend to embark on the substantial task of collecting data for the continent.

The report for Phase II of the Environmental Vulnerability Project was completed in February 2000, Environmental Vulnerability Index (EVI) to summarise national environmental vulnerability profiles. Phase II (SOPAC Technical Report 306).



Some Australians at the SOPAC 28th Session, Nadi, Fiji Islands.

Appendix 1: Summary of 1999 Donor Funding by Programs*

SOURCE OF FUNDS	GRAND TOTAL	TOTAL RESOURCE DEVELOPMENT PROGRAM	TOTAL ENVIRONMENTAL SCIENCE PROGRAM	TOTAL NATIONAL CAPACITY DEVELOPMENT PROGRAM	TOTAL CORPORATE SERVICES PROGRAM	TOTAL WORK PROGRAM MANAGEMENT PROGRAM
Australia - AYA	7694			7694		
Australia - Red Cross	55 216			55 216		
Australia-Annual Grant	550 000	194 000	336 000	20 000		
Australia-Special Grant	668 794			668 794		
Canada	12 000	12 000				
CFTC	455 500	124 900	133 900	196 700		
Commonwealth Foundation	15 900			15 900		
European Union	65 000			65 000		
Fiji	118 200		118 200			
France	243 500		90 500	153 000		
Japan	125 000	125 000				
Korea	33 000	33 000				
Macquarie University	12 000			12 000		
New Caledonia	20 000		20 000			
NZ-Annual Grant	448 600	310 600	49 000			89 000
NZ-Special Grant	736 800		312 500	169 800		254 500
OFDA	30 000			30 000		
People's Republic of China	147 700		147 700			
Taiwan	154 000	133 000		21 000		
United Kingdom (DFID)	115 000	115 000				
United Kingdom (ODI)	133 200			133 200		
UNDMF	288 830			288 830		
UNDP-DRRP	185 354			185 354		
UNEP	40 000			40 000		
United Nations (UN)	599 472	271 800	10 000	317 672		
USAID/GII	76 000		76 000			
Various Donors	136 900	53 600	83 300			
VSO	6000			6000		
TOTAL BUDGET	5 479 660	1 372 900	1 377 100	2 386 160	0	343 500

* (RXB & XB combined)

Appendix 2: Completed Reports & Publications (as at 31 July 1999)

PROCEEDINGS

- SOPAC Secretariat. 1998. Proceedings of the SOPAC twenty-seventh session, hosted by the Government of the Federated States of Micronesia in Suva, Fiji Islands, 26 September – 2 October 1998. Proceedings of the Annual Session of SOPAC 27: 136 p.

TECHNICAL REPORTS

- 256 Rizer, J.P., Lum, J. 1998. Mineral Resources Sector Review: Solomon Islands Government. SOPAC Technical Report 256: 41p.; 1 app.; 1 table; 4 figs.
- 257 Smith, R. (et al) 1998. Impacts of dredging for aggregates from fringing reefs: Pohnpei State: recommendations and alternatives. SOPAC Technical Report 257: 209 p.
- 261 Scholzel, H. 1999. A technical appraisal of the Auki Water Supply System, Malaita Island, Solomon Islands. SOPAC Technical Report 261: 44 p.; 4 app.
- 262 SOPAC Secretariat 1998. A report on the international conference on the radiological situation at the atolls of Mururoa & Fangataufa. SOPAC Technical Report 262: 21 p. Note: Prepared for the South Pacific Forum
- 263 Klein, R. 1998. Hydrodynamic simulation with MIKE21 of Mele Bay and Port Vila, Vanuatu. SOPAC Technical Report 263: 61 p.
- 265 Fifita, S. 1998. Review of the Tonga Solar Rural Electrification Program. SOPAC Technical Report 265.
- 266 Fifita, S. 1999. Review of the Tuvalu Solar Electric Cooperative Society. SOPAC Technical Report 266: 67 p.; 8 annexes
- 267 Smith, R. 1998. Seismic investigation, Kinoya sewer outfall, Laucala Bay, Fiji. SOPAC Technical Report 267: 13 p.; 5 figs.
- 268 Maharaj, R. 1998. Assessment of coastal erosion problems in the outer atoll islands of Pohnpei, Chuuk and Yap states, Federated States of Micronesia. SOPAC Technical Report 268: 26 p.; tables, 33 plates, 5 appendices
- 269 Burke, E. 1998. Demand management and conservation investigations in Funafuti, Tuvalu. SOPAC Technical Report 269: 18 p.
- 270 Smith, R., Saphore, E. 1998. Reservoir sedimentation, Monasavu Hydro Lake. SOPAC Technical Report 270: 47 p.; 4 app.; 17 figs.
- 271 Smith, R. 1999. Reservoir sedimentation Headworks 3, Savura Creek, Fiji. SOPAC Technical Report 271: 11 p.
- 273 Scholzel, H. 1999. Hydraulic modelling of the Nuku'alofa water supply system, Kingdom of Tonga. SOPAC Technical Report 273: 64 p.; appendices
- 274 Fifita, S. 1999. Review of the Marshall Islands Alternative Energy Company. SOPAC Technical Report 274: 68 p.; 10 annexes
- 275 Kaly, U., Briguglio, L., McLeod, H., Schmall, S., Pratt, C., Pal, R. 1999. Environmental Vulnerability Index (EVI) to summarise national environmental vulnerability profiles. SOPAC Technical Report 275: 66 p.; 3 annexes, 2 figs.; 1 table
- 276 McLeod, H. 1999. Niue mineral & aggregate policy. SOPAC Technical Report 276: 17 p.
- 277 Min, G.H., Lee, S.R. 1999. Survey report of sand and aggregate resources at Vava'u, Kingdom of Tonga. SOPAC Technical Report 277: 21 p.; 2 app.; 5 figs.
- 280 Maharaj, R.J. 1999. Contamination risk assessment from WWII armoury in Iron Bottom Sound, Solomon Islands. SOPAC Technical Report 280: 53 p.; 4 figs., 8 tables, 25 plates, 1 app.

- 281 Kim, S.P., Lee, S.R. 1999. Mapping and coastal morphology from Salelolonga to Pu'apu'a in the island of Savai'i, Samoa. SOPAC Technical Report 281: 14 p.; 4 app.; 3 figs.
- 285 He, C. 1999. Coastal mapping to assist with development of a strategy for foreshore protection and development, Rarotonga, Cook Islands. SOPAC Technical Report 285: 55 p.; attachments
- 286 Scott, D., Ricci, G., Fatai, T. 1999. Groundwater assessment, Kingdom of Tonga. SOPAC Technical Report 286: 57 p.
- 287 McLeod, H. (comps.) 1999. Fiji Offshore Mineral Policy Green Paper and supporting documentation. SOPAC Technical Report 287: 93 p.
- 288 Scholzel, H., Bower, R. 1999. Small Scale Wastewater Treatment Plant Project: report on project criteria, guidelines and technologies. SOPAC Technical Report 288: 47 p.
- 292 He, C. 1999. Coastal mapping to assist with development of a strategy for foreshore protection and development, Aitutaki, Cook Islands. SOPAC Technical Report 292: 45 p.; 24 figures
- 293 Kojima, K. 1999. Report on the cobalt-rich manganese crust resources in the waters of the Republic of the Marshall Islands: based on the results of the Japan/SOPAC cooperative study project on the deepsea mineral resources in selected offshore areas of the SOPAC region. SOPAC Technical Report 293: 10 p.; 5 figs.; 2 tables.
- 294 Kojima, K. 1999. Report on the cobalt-rich manganese crust resources in the waters of the Federated States of Micronesia: based on the results of the Japan/SOPAC cooperative study project on the deepsea mineral resources in selected offshore areas of the SOPAC region. SOPAC Technical Report 294: 7 p.; 5 figs.; 2 tables.
- 295 Taylor, P., Talia, L. 1999. Volcanic hazards assessment of Savai'i, Samoa. SOPAC Technical Report 295.
- 297 Fairbairn, P., Mario, R. 1999. Solar water heaters. SOPAC Technical Report 297.
- 298 Cronin, S. 1999. Volcanic hazard and risk assessment for Taveuni, Fiji. SOPAC Technical Report 298.

PRELIMINARY REPORTS

- 98 Min, Geon-Hong 1998. Assessment of marine aggregate resources and sand mining, Vava'u, Tonga. SOPAC Preliminary Report 98. (see also SOPAC Technical Report 277)
- 99 Fournial, F. 1998. Hydrodynamic simulations with MIKE21 for Majuro Atoll, Marshall Islands. SOPAC Preliminary Report 99: 14 p.
- 100 Scott, D. 1998. Vanuatu hydrological baseline studies report of visit, 15-22 August 1998. SOPAC Preliminary Report 100: 22 p. Note: Vanuatu Hydrological Studies. Stage 1: technical assistance to the Department of Geology, Mines and Water Resources
- 101 Scholzel, H. 1998. Vanuatu hydrological baseline studies : Stage 1: technical assistance to the Department of Geology, Mines and Water Resources. SOPAC Preliminary Report 101: 8 p., 3 app.
- 102 McLeod, H. 1998. Niue draft mineral policy. SOPAC Preliminary Report 102: 27 p.
- 103 Maharaj, R. 1999. Preliminary results of contamination risk assessment from WWI armoury in Iron Bottom Sound, Solomon Islands. SOPAC Preliminary Report 103: 31 p.; attachments
- 104 Kojima, K. 1999. Preliminary report on the results of the Japan/SOPAC Deepsea Mineral Resources Survey in the Federated States of Micronesia. SOPAC Preliminary Report 104: 8 p.
- 105 Kojima, K. 1999. Preliminary report on the results of the Japan/SOPAC Deepsea Mineral Resources Survey in the Republic of the Marshall Island waters. SOPAC Preliminary Report 105: 9 p.
- 106 Bower, R. 1999. Small-scale wastewater treatment plant project (SSWWTPP) village assessment in Kadavu, Fiji, 22-25 February 1999. SOPAC Preliminary Report 106: 14 p.

- 107 Scott, D. 1999. Water sector database development Samoa. SOPAC Preliminary Report 107: 23 p.
- 109 Scholzel, H. 1999. Small-Scale Wastewater Treatment Plant Project (SSWWTPP) - report of visit to the Kingdom of Tonga, 2-9 March 1999. SOPAC Preliminary Report 109: 25 p.
- 110 Bower, R. 1999. Small-scale wastewater treatment plant project - report of visit to Niue Islands, 6-12 June 1999. SOPAC Preliminary Report 110: 32 p.; 7 app
- 111 Maharaj, R. 1999. Assessment of onshore aggregate resources, Pohnpei, Federated States of Micronesia. SOPAC Preliminary Report 111: 18 p.; 3 app.
- 113 Scholzel, H. 1999. Small scale wastewater treatment plant project: report on project inception, 2-9 March 1999. SOPAC Preliminary Report 113: 20 p.
- 114 Scholzel, H. 1999. Small scale wastewater treatment plant project: report on visit to the Republic of Marshall Islands, 3-10 June 1999. SOPAC Preliminary Report 114: 32 p.
- 116 He, C., Chung, Q. 1999. Resurvey of Bikenibeu beach profiles, South Tarawa, Kiribati, 9-13 August 1999. SOPAC Preliminary Report 116: 20 p.; 2 figs

MISCELLANEOUS REPORTS

- 294 Fairbairn, P. 1998. Mini workshop on Solar Hot Water System Monitoring Workshop, 1 April 1998. SOPAC Miscellaneous Report 294: [various paging]
- 298 Burke, E. 1998. Pacific Water Association. Report of the meeting on possible collaboration with the World Plumbing Council, held at SOPAC Secretariat, Suva, Fiji, 10 September 1998. SOPAC Miscellaneous Report 298; PWA Miscellaneous Report 1: 9 p., 1 app.
- 301 Burke, E. 1998. Report on the 40th Annual Conference and Expo of the New Zealand Water Wastes Association held in Wellington, New Zealand, 22-25 September 1998. SOPAC Miscellaneous Report 301: 18 p.
- 302 Burke, E. 1998. Demand Management and Conservation Project field investigations in South Tarawa, Kiribati, 13-20 October 1998. SOPAC Miscellaneous Report 302: 18 p.
- 303 Burke, E. 1998. Nauru reconnaissance report, 20-22 October 1998. SOPAC Miscellaneous Report 303: 6 p.
- 304 Allinson, L. 1998. Internet access and pricing in Fiji (initiatives for small island states). SOPAC Miscellaneous Report 304: 7 p.
- 305 McLeod, H. (comp.) 1998. Pacific Exploration Technology (PET 98) Tanoa International Hotel, Nadi, Fiji, 23 - 25 September 1998: Abstracts volume. SOPAC Miscellaneous Report 305: 55 p.
- 306 McLeod, H. 1998. Pacific Exploration Technology 98 Conference: 23-25 September 1998, Tanoa International Hotel, Nadi, Fiji. SOPAC Miscellaneous Report 306: 9 p., 8 app.
- 307 McLeod, H. 1998. Theoretical perspective on the derivation and justification of compensation for damages to land from mining and other similar activities. SOPAC Miscellaneous Report 307: 23 p.
- 308 McLeod, H., Naidu, V. 1998. Application of economic theory on compensation. SOPAC Miscellaneous Report 308: 16 p.
- 309 Scott, D. 1998. Y2K workshop and 5th SPREP meeting of Regional Meteorological Services Directors. SOPAC Miscellaneous Report 309: 18 p. Note: Meeting papers appended as attachment
- 310 Forstreuter, W. 1998. LOME III Pacific Regional Energy Programme: Project No. 6-RPR-ACP-528: Report 6 May 1998 - 5 November 1998. SOPAC Miscellaneous Report 310: 27 p.
- 311 Fairbairn, P.L. 1998. A regional view towards sustainable renewable energy development in the Pacific. SOPAC Miscellaneous Report 311: 11 p.; 3 annexes
- 312 Martin, F. 1998. PEPA-IS phase I: a GIS for environment, Federated States of Micronesia. SOPAC Miscellaneous Report 312: various pagings Note: Includes Manual

- 313 Liava'a, E., Hemaloto, P. 1998. TEPB GIS programming manual: preliminary version 26 August 1998. SOPAC Miscellaneous Report 313: 102 p.
- 314 Ali, Z. 1998. Information system development: SOPAC Disaster Management Unit. SOPAC Miscellaneous Report 314: 4 p.; 1 app.
- 315 Fairbairn, P. 1998. Workshop report: SPC-SOPAC Joint Regional Energy Program Design: 20-24 July 1998, Nadi, Fiji Islands. SOPAC Miscellaneous Report 315: various pagings
- 316 Forstreuter, W. (comps.) 1998. Pacific Regional Energy Programme Workshop GIS for Utilities, 21-23 October 1998. SOPAC Miscellaneous Report 316: various pagings. Note: The GIS project was implemented by PREP, TEPB, FEA, SIEA and SOPAC under European Union funding
- 317 Forstreuter, W. 1998. GIS & Remote Sensing Workshop run by SOPAC in conjunction with the Environmental Planning Unit, Department of Justice, 7-11 December 1998, Niue. SOPAC Miscellaneous Report 317: various pagings
- 319 Butler, P., Coleman, P.J. (comps.) 1999. Promotion of petroleum acreages in the Southwest Pacific: a part of a world wide coverage. SOPAC Miscellaneous Report 319: 18 p.
- 320 McLeod, H. 1999. Offshore mineral policy workshop, Madang, Papua New Guinea, 22-26 February 1999. SOPAC Miscellaneous Report 320: 35 p.; 7 annexes
- 322 Maharaj, R.J. 1999. Report of a United Nations Framework Convention on Climate Change (UNFCCC): experts meeting on coastal adaptation technologies, UNFCCC Secretariat, Haus, Carstanjen, Bonn, Germany, 22-23 March 1999. SOPAC Miscellaneous Report 322. Conference: Experts meeting on coastal adaptation technologies (1999 : Bonn, Germany)
- 323 SOPAC Secretariat 1999. Workshop report. SOPAC Miscellaneous Report 323: 149 p. Conference: Offshore Mineral Policy Workshop (1999 : Madang, Papua New Guinea)
- 325 Allinson, L. 1999. Internet access and pricing in the Pacific, Fiji Internet Group: Vision for Fiji and the Pacific. SOPAC Miscellaneous Report 325: 10 p.
- 326 SOPAC Secretariat 1999. GIS & remote sensing SOPAC policy paper. (v.2.3) SOPAC Miscellaneous Report 326: 4 p.
- 328 SOPAC Secretariat. Energy Unit 1999. Modifications to national energy demand/supply database, Palau. SOPAC Miscellaneous Report 328: 8 p.; 9 annexes
- 329 SOPAC Secretariat. Energy Unit 1999. Modifications to national energy demand/supply database: Nauru. SOPAC Miscellaneous Report 329: 8 p.; 9 annexes
- 330 Allinson, L. 1999. Meteorology information system report and recommendations. SOPAC Miscellaneous Report 330: 4 p.
- 331 Allinson, L. 1999. Meteorology information system user's guide. SOPAC Miscellaneous Report 331: 8 p.
- 332 Maharaj, R.J. 1999. Report on presentation of the United Nations Framework Convention on Climate Change (UNFCC): technical paper on coastal adaptation technologies (FCCC/TP1999/1): 10th meeting of the Subsidiary Bodies on Scientific and Technological Advice (SBSTA), Hotel Maritim, Bonn, Germany, 9th June 1999. SOPAC Miscellaneous Report 332. Conference: Meeting of the Subsidiary Bodies on Scientific and Technological Advice (SBSTA) (10th : 1999 : Bonn, Germany)
- 337 Allinson, L. 1999. Meteorology Information System upgrade proposal. SOPAC Miscellaneous Report 337: 11 p.
- 338 SOPAC Secretariat. Energy Unit 1999. Modifications to national energy demand/supply database, Kosrae, Federated States of Micronesia. SOPAC Miscellaneous Report 338: 8 p.; 8 annexes
- 339 SOPAC Secretariat. Energy Unit 1999. Modifications to national energy demand/supply database, Pohnpei, Federated States of Micronesia. SOPAC Miscellaneous Report 339: 8 p.; 8 annexes
- 343 SOPAC Secretariat. Energy Unit 1999. Modifications to national energy demand/supply database, Chuuk, Federated States of Micronesia. SOPAC Miscellaneous Report 343: 8 p.; 8 annexes

- 344 SOPAC Secretariat. Energy Unit 1999. Modifications to national energy demand/supply database, Yap, Federated States of Micronesia. SOPAC Miscellaneous Report 344: 8 p.; 8 annexes
- 346 Allinson, L. 1999. GIS and remote sensing capacity: workshop on the enhancement of regional GIS facilities, 2-6 August 1999. SOPAC Miscellaneous Report 346: 13 p.; 3 attachments
- 347 Maharaj, R.J. 1999. Coastal erosion & management in Federated States of Micronesia (FSM): report of a technical paper presented to Congress/Government of the Federated States of Micronesia, 30th July 1999, Cliff Rainbow Hotel, Kolonia, Pohnpei, FSM. SOPAC Miscellaneous Report 347: 38 p.
- 348 McLeod, H. 1999. Report on the Intergovernmental Panel on Climate Change (IPCC) Expert Meeting on Small Island States, Valletta, Malta, 19-22 July 1999. SOPAC Miscellaneous Report 348
- 355 Crook, K.A.W., Rodda, P. (eds.) 1999. Abstracts of papers presented at the STAR session. SOPAC Miscellaneous Report 355
- 356 Burke, E. 1999. Recommendations for disaster preparedness of water and sanitation systems in Pacific Small Island Developing States. SOPAC Miscellaneous Report 356: 24 p.; 2 app.

TRAINING REPORTS

- 77 Lekelalu, I. 1998. Guadalcanal plains, Solomon Islands: groundwater availability guide. SOPAC Training Report 77: various pagings
- 82 Collen, J. 1999. Pacific research in geology, School of Earth Science, Victoria University of Wellington, New Zealand - progress report 1999. SOPAC Training Report 82: 4 p.

JOINT CONTRIBUTION REPORTS

- 124 Berry, G. 1998. The use of composted human excreta as a fertilizer: report on applied research study. 69 p.
- 125 JICA/MMAJ. 1999. Report on the cooperative study project on the deepsea mineral resources in selected offshore areas of the SOPAC region: (Volume 4-1): sea area of the Republic of the Marshall Islands. SOPAC Joint Contribution 125.
- 126 JICA/MMAJ. 1999. Report on the cooperative study project on the deepsea mineral resources in selected offshore areas of the SOPAC region: (Volume 4-2) : sea area of the Federated States of Micronesia. SOPAC Joint Contribution 126.

ROUTINE PUBLISHING & PROMOTIONAL PROJECTS

Annual Report Summary 1998

2 issues SOPAC News

2 issues SOPAC Projects

2 issues Pacific GIS & Remote Sensing newsletter

SOPAC Unit Profiles

SOPAC Strategic Plan 1999-2001

SOPAC Trip Reports (numbers 262 & 263)

EXTERNAL PUBLISHING PROJECTS

UNDHA/SPPO 7th South Pacific Regional IDNDR Disaster Management Meeting, Nadi, Fiji Islands, 23-25 September 1998.

Tonga Water Board Annual Report 1998

Manganese Nodules of the Cook Islands, Revised edition

Appendix 3: Secretariat Staff List (as at 31 July 1999)

SOPAC-paid employees are listed with the date they joined SOPAC, and the start and finish date of their current contract.

In-kind staff provided by donors and support organisations are listed with the date they joined SOPAC in italics.

SECTIONS	NAME	COUNTRY OF ORIGIN	DATE JOINED	CONTRACT START	CONTRACT END
RESOURCE DEVELOPMENT PROGRAM					
1 Program Assistant	Laisa Baravilala-Baoa	Fiji	July 1987	Permanent	
Mineral Resources Unit					
2 Marine Geologist	Jackson Lum	Fiji	Nov 1992	Nov 1998	Nov 2001
3 Offshore Geologist	Kazuhiro Kojima	Japan	Sep 1998		Feb 2000
4 Resource Economist	Helena McLeod	UK	Oct 1997	Oct 1997	Dec 1999
5 Senior Geology Technician	Sekove Motuiwaca	Fiji	Apr 1980	Permanent	
Water Resources Unit					
6 Environmental Engineer	vacant				
7 Hydrogeologist	David Scott	New Zealand	Jul 1997		Jul 1999
8 Hydraulic Engineer	Harald Schoelzel	Germany	Mar 1997		Mar 2000
9 Hydrogeologist	Giovanni Ricci	Italy	Oct 1996		Sept 1999
10 Workshop Assistant	Setareki Ratu	Fiji	Oct 1986	Permanent	
Energy Unit					
11 Energy Coordinator	Paul Fairbairn	New Zealand	Jan 1998	Jan 1998	Jan 2000
12 Energy Advisor	Solomone Fifita	Tonga	Jan 1998	Jan 1998	Dec 1999
ENVIRONMENTAL SCIENCE PROGRAM					
13 Program Assistant	Sisilia Gravelle	Fiji	Sep 1998	Permanent	
Coastal Unit					
14 Marine Geophysicist	Robert Smith	Australia	Oct 1998	Jul 1998	Jun 2001
15 Coastal Geologist	Russell Mahara	Trinidad & Tobago	Jun 1998		Jun 2001
16 Coastal Geologist	Chao Xiong He	China	July 1998		Jul 2000
17 Senior Electronics Technician	Simon Young	Fiji	Jan 1993	Jan 1999	Jan 2002
18 Electronics Technician	Peni Musunamasi	Fiji	Jun 1989	Permanent	
Hazard Assessment Unit					
19 Coastal Engineering Geologist	Graham Shorten	Australia	Oct 1995	Jan 1999	Jan 2002
20 Technical Support Assistant	Graeme Frost	Fiji	Mar 1992	Permanent	
Ocean Unit					
21 Offshore Coordinator	vacant				
NATIONAL CAPACITY DEVELOPMENT PROGRAM					
22 Vive Vuruya	Program Assistant				
Human Resource Development Unit					
23 Training Coordinator	Andrew Butcher	United Kingdom	Feb 1997		Jun 2000
Disaster Management Unit					
24 Technical Advisor	Joseph Chung	Fiji	Jul 1998		
25 Associate Expert	Angelika Planitz	Germany	Jul 1998		
26 Disaster Mitigation Advisor	Atu Kaloumalra	Fiji	Jul 1998		
27 Disaster Management Training Advisor	Joeli Rokovada	Fiji	Jul 1998		
28 Unit Assistant	Marie Yee	Fiji	Jul 1998		
Information Technology Unit					
29 Information Technology Manager	Les Allinson	Australia	Nov 1992	Nov 1998	Oct 2001
30 Database Development Officer	Franck Martin	France	Sep 1993	Apr 1999	Jan 2000
31 Computer Geologist	Olivier Duperray	France	Jan 1998		Jan 1999
32 Computer Operator	Anna Elaise	Fiji	Jul 1990	Permanent	

SECTIONS	NAME	COUNTRY OF ORIGIN	DATE JOINED	CONTRACT START	CONTRACT END
Publications and Library Unit					
33 Publications Coordinator	Lala Bukarau	Fiji	Nov 1985	Sept 1999	Sep 2000
34 Library/Program Assistant	Sunita Prasad	Fiji	May 1989	Permanent	
CORPORATE SERVICES PROGRAM					
35 Program Assistant	Annette Warbrooke	Fiji	Oct 1990	Permanent	
36 Executive Assistant	Litia Waradi	Fiji	Apr 1989	Permanent	
Management Unit					
37 Director	Alfred Simpson	Fiji	Feb 1995	Feb 1998	Feb 2001
38 Deputy Director	vacant				
39 Program Manager	Russell Howorth	New Zealand	Nov 1986	Mar 1999	Mar 2001
40 Finance & Administration Controller	Mohinish Kumar	Fiji	Mar 1995	Mar 1998	Mar 2001
Finance Unit					
41 Accountant	Makereta Kaurasi	Fiji	Apr 1998	Apr 1998	Apr 2001
42 Assistant Accountant	Atesh Narayan	Fiji	Jan 1993	Permanent	
Administration Unit					
43 Administrative Assistant	Nazmeen Whippy	Fiji	Jul 1986	Permanent	
44 Receptionist/Clerk	Unaisi Bainiloga	Fiji	Feb 1987	Permanent	
45 Driver/Clerk	Enele Gaunavou	Fiji	Jul 1988	Permanent	
46 Office Assistant Cleaner	Niu Daurewa	Fiji	Sep 1987	Permanent	

Appendix 4: 1999 Revised Budget and 2000 Approved Budget

Summary of Anticipated Income (including in-kind support contribution) and Expenditure by Programs

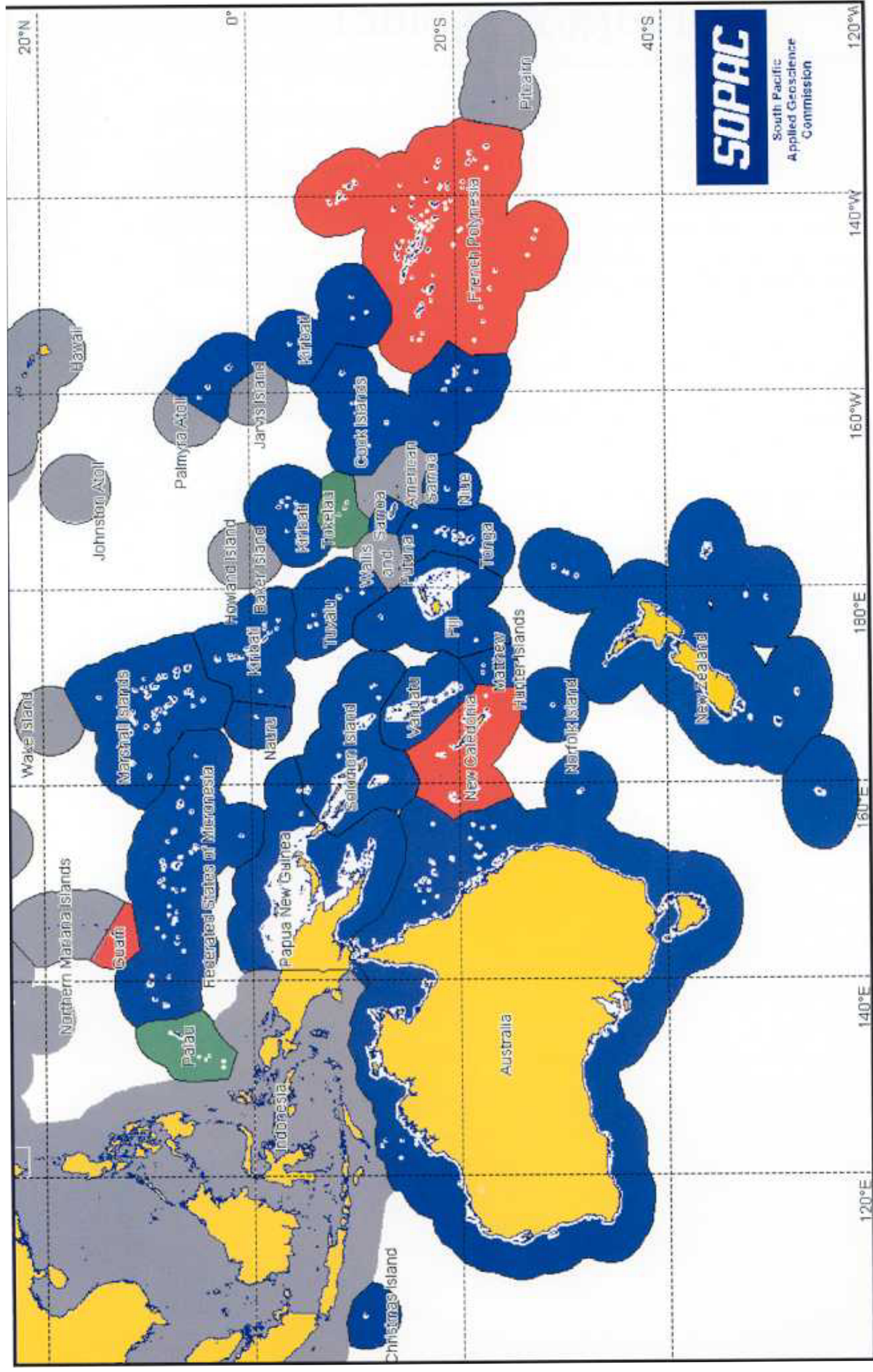
	1999 Revised Budget F\$	2000 Approved Budget F\$
PROGRAM HEADS		
Resource Development Program	1 497 700	2 675 317
Environmental Science Program	1 593 000	2 092 272
National Capacity Development Program	3 027 660	3 074 238
Corporate Services Program	1 003 000	951 500
Work Program Management Program	560 500	315 000
TOTAL	7 681 860	9 108 327

Appendix 5: Abbreviations used in this Report

AGSO	– Australian Geological Survey Organisation
APEC	– Asian-Pacific Economic Commission
CPU	– coastal protection units
CROP	– Committee of Regional Organisations of the Pacific (formerly SPOCC)
CSD	– Commission of Sustainable Development (of United Nations)
CTD	– conductivity, temperature and depth
DGMWR	– Department of Geology, Mines and Water Resource (Vanuatu)
DHI	– Danish Hydraulics Institute
ECOWOMAN	– Pacific Women & Her Environment: A better life for Communities through Science and Technology
EEZ	– Exclusive Economic Zone
ENSO	– El Niño/Southern Oscillation
EPA	– Environmental Protection Agency
ESCAP	– Economic and Social Commission for Asia and the Pacific (UN)
ESMG	– Earth Science and Marine Geology (SOPAC Certificate Course)
EU	– European Union
EVI	– Environmental Vulnerability Index
FAO	– Food and Agriculture Organisation
FAQ	– frequently asked questions
FIG	– Fiji Internet/Intranet Group
FIT	– Fiji Institute of Technology
FNTC	– Fiji National Training Council
FOC	– Forum Officials Committee
FSM	– Federated States of Micronesia
FSP	– Foundation for the Peoples of the South Pacific
GEBCO	– General Bathymetric Chart of the Oceans
GII	– Geophysical Institute of Israel
GIS	– Geographic Information System
GPS	– Global Positioning System
HLC	– high-level consultations

IFREMER	– Institut Française de Recherche pour l'Exploitation de la Mer (formerly CNEXO) (French Oceanographic Research Institute)
IGODS	– Interactive Graphical Ocean Data System
IHO	– International Hydrographic Organisation (of IOC/UNESCO)
IOC	– Intergovernmental Oceanographic Commission (of UNESCO, Paris)
ISA	– International Seabed Authority
ISP	– Internet Service Provider
IT	– Information Technology
JAMSTEC	– Japan Marine Science and Technology Center
JICA	– Japan International Cooperation Agency
KIGAM	– Korea Institute of Geology, Mining and Materials
LAN	– Local Area Network
LPG	– Liquid Petroleum Gas
MBES	– multi-beam echo sounder
MMAJ	– Metal Mining Agency of Japan
MOWEPP	– Ministry of Works, Energy & Physical Planning (Cook Islands)
MRD	– Mineral Resources Department (Fiji Islands)
MSR	– Marine Scientific Research
NGDC	– National Geophysical Data Center (US)
NIWA	– National Institute for Water and Atmospheric Research (NZ)
ORSTOM	– Institut Française de Recherche Scientifique pour le Développement en Coopération (formerly Office de la Recherche Scientifique et Technique Outre-Mer) (French Institute of Scientific Research for Cooperative Development)
PABX	– Private Area Branch Exchange
PET	– Pacific Exploration Technology
PIC	– Pacific Island Country
PICCAP	– Pacific Island Climate Change Assistance Project
PREP	– Pacific Regional Energy Program
PV	– photo-voltaic
RAO	– Regional Approving Office (EU)
ROC	– Republic of China
ROV	– remotely-operated vehicles
SIDS	– Small Island Developing States
SOPAC	– South Pacific Applied Geoscience Commission

SPACHEE	– South Pacific Action Committee for Human Ecology and Environment
SPC	– Secretariat of the Pacific Community
SPDRP	– South Pacific Disaster Reduction Programme (UNDP)
SPOCC	– South Pacific Organisations Coordinating Committee (see CROP)
SPREP	– South Pacific Regional Environmental Program
STAR	– Science, Technology and Resources Network
TCSP	– Tourism Council of the South Pacific
TRITON	– Triangle Trans-Ocean Buoy Network
UN	– United Nations
UNCLOS	– United Nations Convention on the Law of the Sea
UNDHA/SPPO	– United Nations Department of Humanitarian Affairs/South Pacific Program Office
UNDP	– United Nations Development Programme
UNEP	– United Nations Environment Programme
UNESCO	– United Nations Educational Scientific and Cultural Organisation
UNICEF	– United Nations Children's Fund
USP	– University of the South Pacific
WAN	– Wide Area Network
WHO	– World Health Organisation
WWII	– World War Two
WWD	– World Water Day
WSSCC	– Water Supply & Sanitation Collaborative Council



SOPAC member countries' EEZ territories are the red and blue areas.