

ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC
Committee for Co-ordination of Joint Prospecting for
Mineral Resources in South Pacific Offshore Areas
(CCOP/SOPAC)

Proceedings of the Seventh Session

Wellington, New Zealand
9-16 October 1978

including
Report of the Seventh Session
of its Technical Advisory Group
and
Technical Documentation

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CCOP/SOPAC
September 1979*

COVER PHOTO

UNDP's charter vessel, the schooner *Machias*, in Rabaul Harbour at the end of CCOP/SOPAC's Papua New Guinea 1979 Offshore Survey.
(Photo: J.C. McDougall, N.Z. Oceanographic Institute, Wellington)

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PREFACE

The Committee for Co-ordination of Joint Prospecting for Mineral Resources in South Pacific Offshore Areas (CCOP/SOPAC) is an intergovernmental body established under the sponsorship of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP, formerly ECAFE) to develop and promote the investigation of the mineral potential, including petroleum, of the shelves, platforms, and ocean floor in the South Pacific Ocean. At the time of its Seventh Session, the member Governments of CCOP/SOPAC were Cook Islands, Fiji, Gilbert Islands, New Hebrides, New Zealand, Papua New Guinea, Solomon Islands, The Kingdom of Tonga, and Western Samoa.

The need for assistance to the developing countries of the South Pacific in this field was first brought to the attention of ECAFE by the representative of Fiji at the Joint (Eighth) Session of the ECAFE Working Party of Senior Geologists and Sub-Committee on Mineral Resources Development (Bandung, Indonesia, August 1970); interest had been aroused in the petroleum potential of the submerged platform areas in the South Pacific after the discovery in 1968 of seepages of crude oil in Tonga. The attention being given to the possibilities of finding economic deposits of detrital heavy minerals in beaches and near-shore areas of some of the countries, and investigations of the feasibility of mining manganese nodules from the ocean floor for their metallic content, increased the need for a co-ordinated approach and guidance to the South Pacific countries which had, as yet, little or no experience in these activities.

At the subsequent meetings of the ECAFE Committee on Industry and Natural Resources (Bangkok, January/February 1971) and the Commission Session (Manila, April 1971) further support was given by other countries in the South Pacific region to the proposal to form a co-ordinating committee for offshore prospecting in the South Pacific. As a result, the ECAFE Secretariat convened a Preparatory Meeting at Manila in July 1971 to arrange the establishment of the new body. The Inaugural (First) Session of CCOP/SOPAC was held at Suva, Fiji, in 1972; its Second Session at Nuku'alofa, Tonga, in 1973; its Third Session at Apia, Western Samoa, in 1974; its Fourth Session at Honiara, Solomon Islands, in 1975; its Fifth Session at Rarotonga, Cook Islands, in 1976; its Sixth Session at Port Moresby, Papua New Guinea, in 1977; and its Seventh Session at Wellington, New Zealand, in 1978.

The sessions of CCOP/SOPAC have been attended by technical advisers provided by the following Governments, at their own expense, to give guidance

to the Committee on the technical aspects of its activities: Australia, France, the Federal Republic of Germany, Japan, the Union of Soviet Socialist Republics, the United Kingdom, and the United States. Observers from Federal Republic of Germany, Nauru, Norway, Trust Territories of the Pacific Islands, the South Pacific Bureau for Economic Co-operation (SPEC), the United Nations Development Programme (UNDP), the United Nations Educational, Scientific and Cultural Organization (UNESCO) and its associated Intergovernmental Oceanographic Commission (IOC), the University of Papua New Guinea, and the University of the South Pacific have attended the CCOP/SOPAC sessions.

Since the appointment of a UNDP Marine Geologist and establishment of a Technical Secretariat in late 1974 CCOP/SOPAC has been supported by many countries and international organizations.

The Technical Secretariat has its headquarters in Suva, where the Fiji Government has generously provided accommodation at the Mineral Resources Division. Member countries have supported the Secretariat especially during the survey work by providing personnel, facilities (including ships), equipment, and supplies.

Several countries have generously provided much support to the Committee's activities, including direct financial support (Australia, New Zealand, and USA); the services of non-reimbursable consultants (Australia, Japan, and New Zealand); shipboard training (Japan and USA); equipment gifts and loans (Japan, Australia, and USA); and publishing and printings costs (Australia and New Zealand).

The United Nations Development Programme (UNDP) has supported the Committee since the establishment of its Technical Secretariat in September 1974 by financing a preparatory assistance project. During this time two technical missions, financed by UNDP, visited member countries of CCOP/SOPAC and interested neighbouring countries. As a result of the recommendations of these missions, UNDP offered further support to CCOP/SOPAC by increasing its financial assistance to the region, especially to support investigations of mineral potential on the sea bed and in adjacent areas. This increased assistance is to commence in 1979, and should continue for a period of at least three years.

The Intergovernmental Oceanographic Commission (IOC) has assisted the Committee by supporting the attendance of experts at meetings to develop long-range projects in the South Pacific, and by sup-

porting trainees from member countries, allowing them to participate in training courses and survey cruises.

In recent sessions the attention of the Committee has been drawn to the results of survey work and data reassessment on prospects of petroleum, manganese nodules, submarine phosphate, precious coral, metalliferous sediments, detrital gold, and submerged bauxite. Results have been published in the South Pacific Marine Geological Notes and in CCOP/SOPAC Technical Bulletins. Survey work has been carried out using personnel, ships, equipment, and facilities provided both by member countries and

by UNDP through the Technical Secretariat. Training of member country personnel has been effective through participation on survey cruises in member country waters, on research vessels from supporting countries, and at two training courses held in Suva, Fiji. Programme planning for work of the Committee has been greatly assisted by the joint CCOP/SOPAC — IOC IDOE International Workshop, the joint CCOP/SOPAC — University of Hawaii — IOC-sponsored *Ad Hoc* Meeting of specialists on the Geodynamics of the Fiji Plateau, and the CCOP/SOPAC Workshop on Precious Corals. To carry out work in the region the Committee now has a total of 74 country projects and 20 regional projects in its work programme.

The Committee has been requested to continue its work in the region, and to report on its progress to the General Assembly of the United Nations.

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Part 1: REPORT OF THE COMMITTEE, SEVENTH SESSION

(Document E/ESCAP/L.29, 20 December 1978, submitted to the thirty-fifth session of the United Nations Economic and Social Commission for Asia and the Pacific, 5-16 March 1979, Manila.)

I. Organization of the session

1. The seventh session of the Committee for Co-ordination of Joint Prospecting for Mineral Resources in South Pacific Offshore Areas (CCOP/SOPAC) was held at Wellington, New Zealand, from 9 to 16 October 1978, and the seventh session of its Technical Advisory Group from 9 to 12 October 1978.

2. At the opening of the session, participants stood in silence as a token of respect for the late Mr W. Bullerwell, whose advice and support in the early stages of the Committee had been of great value, and deeply appreciated by all concerned.

Attendance

3. The session was attended by representatives of the following member countries of CCOP/SOPAC: Cook Islands, Fiji, New Hebrides (new member), New Zealand, Papua New Guinea, Samoa, Solomon Islands, and Tonga. Representatives of the Gilbert Islands were unable to attend, but had informed the Chairman for the sixth session of their continuing interest in the Committee, and of their endorsement of the United Nations Development Programme (UNDP) technical review mission report and project document.

4. Technical advisers whose services had been provided by the Governments of Australia (1), France (2), the Union of Soviet Socialist Republics (3), the United Kingdom of Great Britain and Northern Ireland (1), and the United States of America (3) also attended.

5. A representative of the Economic and Social Commission for Asia and the Pacific (ESCAP) also attended. The United Nations Development Programme was represented by an Assistant Regional Representative from the South Pacific Regional Office and the Senior Technical Adviser from UNDP headquarters. The Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (IOC/UNESCO) was represented by the Deputy Secretary of IOC. Observers on behalf of the Federal Republic of Germany, Norway, and the South Pacific Bureau for Economic Co-operation (SPEC) also attended.

Opening address

6. In his message to the Committee, which was delivered by the Chief of the Natural Resources

Division, the Executive Secretary of ESCAP thanked the Government of New Zealand for its hospitality in providing host facilities for the seventh session. He referred to the recent fielding of a UNDP review mission and the formulation of a draft project proposal involving the expenditure of about \$2.5 million over three years, and informed the meeting that UNDP had already conveyed its general endorsement of the proposal. That would increase the responsibilities of the Committee in ensuring that the programme was planned and carried out in such a way as to make the most effective use of the available resources. The importance of effective liaison with other bodies involved in exploration of the area was also stressed.

7. Dr E.I. Robertson, Director-General of the Department of Scientific and Industrial Research (DSIR), Wellington, made a statement on behalf of the Hon. L.W. Gandar, M.P., Minister for Science and Technology, who regretted his inability to be present. In his message, the Minister stressed the importance of the Committee's activities in co-operative appraisal of resources, since the task was beyond the capability of any one country. In opening the session, Dr Robertson recalled that in comparatively recent years exploration of offshore resources had assumed increasing importance, as indicated by the discovery and development of the Maui gas field off the west coast of the North Island of New Zealand and studies of the phosphate deposits on the Chatham Rise. At the same time, New Zealand had been actively involved in work in support of other members. In pursuing the Committee's activities, each member had a contribution to make, and by stimulating the free exchange of information the Committee could help to ensure the most effective use of the collective resources.

Election of Officers

8. Dr D. Kear, Assistant Director-General, DSIR (New Zealand), was elected Chairman and Mr S. Kingan, Senior Scientific Research Officer (Cook Islands), Vice-Chairman. The Committee appointed Mr J.E. Wright (United Kingdom) to serve as Chairman of the Committee's Technical Advisory Group (TAG), and Mr G. Shepherd as Rapporteur.

Adoption of the agenda

9. The following agenda was adopted:

Plenary session

1. Opening of the session
2. Election of the Chairman and Vice-Chairman

3. Adoption of the agenda of the plenary session
4. Admission of new members and designation of national representatives
5. Appointment of the Chairman of the Technical Advisory Group (TAG)

TAG session

1. Adoption of the agenda of the TAG session
2. Review of activities, since the sixth session, of
 - (a) CCOP/SOPAC Technical Secretariat
 - (b) ESCAP Secretariat
3. Review of survey activities: progress and results
 - (a) Activities in the CCOP/SOPAC work programme
 - (b) Other activities
4. Data and information management
5. CCOP/SOPAC publications
6. Training: programmes and requirements
7. Advances in technology for exploration and development of marine mineral resources
8. Evaluation of resources and their significance
9. Reports on developments in related areas of activity
 - (a) Energy
 - (b) Law of the sea
10. Consideration of the report of the UNDP technical review mission
11. Review of the draft document in the light of the review mission's recommendations
12. Formulation of the work programme
13. Review of the terms of reference of CCOP/SOPAC
14. Adoption of the report of TAG

Plenary session (continued)

6. Consideration of the report of TAG
7. Other business
8. Arrangements for the eighth session
9. Adoption of the report
10. Closure of the session

II. Admission of new members and designation of national representatives

10. The Committee received and approved the application of the Government of the New Hebrides for membership of the Committee, and warmly welcomed the two designated representatives.

11. The Committee noted the designation of national representatives, as follows:

Cook Islands – Mr G. H. Sawtell (Secretary of the Premier's Department)

Fiji – Mr R.N. Richmond (Director of Mineral Development)

Gilbert Islands – Mr R.O. Campbell (Secretary of the Department of Resource Development)

New Hebrides – Dr J.L. Saos (Director of Mineral Resources Department) jointly with
Mr A. Macfarlane (Senior Geologist, Geological Survey)

New Zealand – Dr D. Kear (Assistant Director-General, Department of Scientific and Industrial Research)

Papua New Guinea – Mr N.R. Agonia (Secretary, Department of Minerals and Energy)

Samoa – Mr P.D. Muller (Chairman of the Public Service Commission)

Solomon Islands – Dr B.D. Hackman (Chief Geologist, Geological Division, Ministry of Natural Resources)

Tonga – Mr S.L. Tongilava (Superintendent of Lands, Survey and Natural Resources)

III. Consideration of the report of the Technical Advisory Group

12. The Committee adopted the report and recommendations of TAG, including the recommended work programme for 1979. It noted with great satisfaction that agreement had been reached on the UNDP project document (RAS/78/044/A/01/01) for a three-year project starting on 1 January 1979, and that the document would be signed on behalf of six member countries at the closing meeting on 16 October 1978.

13. The Committee expressed its sincere appreciation to the many Governments and institutions which had contributed to the activities of CCOP/SOPAC.

14. It also expressed appreciation to the Chairman and members of TAG for their advice and guidance, and its gratitude to the Governments of Australia, France, the USSR, the United Kingdom, and the United States for providing the services of their experts.

15. The report of TAG is attached as Annex I, the Work Programme as Annex II, the List of Documents as Annex III, the List of Maps, Charts, and Publications as Annex IV, and the List of Participants as Appendix I.

IV. Other business

16. The ESCAP representative referred to an enquiry which had been sent to representatives, seeking an indication of any interest in a number of matters related to the Committee's interests. It was agreed that it would be appropriate to include tsunami warning and seismicity among the items on which reports might be presented at the following session under "Related areas of activity".

V. Arrangements for the eighth session of CCOP/SOPAC

17. The representative of Fiji advised that approval had been sought for Fiji to provide host facilities for the eighth CCOP/SOPAC session, to be preceded by the petroleum symposium provided for in the UNDP project. The Committee expressed its appreciation, and agreed that the next session should, if possible, be held in Fiji in conjunction with the petroleum symposium.

18. With regard to timing, it was agreed that in order to reduce the likelihood of interference with the cruise programme, the session should be held before that of CCOP. The petroleum symposium should be held before the CCOP/SOPAC session.

VI. Adoption of the report and closure of the session

19. The Committee adopted its report on 16 October 1978.

20. The Committee expressed its thanks to the Minister for Science and Technology and his staff for the excellent facilities and services provided for the session, the study tour, and the cruise, and for the generous hospitality extended in many ways. Ap-

preciation was also expressed to the representatives of UNDP for assistance, particularly in finalizing the project document.

VII. Summary of conclusions and recommendations

21. The Committee:

1. Approved the application of the Government of the New Hebrides for membership (para. 10).
2. Adopted the report and recommendations of TAG, including the recommended work programme (para. 12).
3. Noted that agreement had been reached on the UNDP project document, and that the document would be signed by six member countries (para. 12).
4. Agreed that reports on tsunami warning and seismicity might be presented at the next session (para. 16).
5. Agreed that the next session should, if possible, be held in Fiji in conjunction with the petroleum symposium (para. 17).
6. Agreed that the petroleum symposium should be held before the eighth session of CCOP/SOPAC which, in turn, should be held before the CCOP session (para. 18).
7. Strongly supported the principle of a cash contribution to be used to train regional staff to form the nucleus of appropriate intergovernmental institutions (Annex I, para. 76).
8. Requested ESCAP, in that connexion, to prepare and submit a proposal for a suitable intergovernmental body for consideration (Annex I, para 83).

ANNEX I

REPORT OF THE TECHNICAL ADVISORY GROUP

Organization of the session

1. The seventh session of the Technical Advisory Group (TAG) was held at Wellington, New Zealand, from 9 to 12 October 1978 under the chairmanship of Mr J.E. Wright (United Kingdom).

Review of activities of the CCOP/SOPAC Technical Secretariat

2. A review of the activities of the Technical Secretariat since the sixth session was presented by the Acting Project Manager of the UNDP South Pacific Offshore Prospecting Project (RAS/72/122).
3. Activities included assistance to member countries in planning and carrying out marine surveys and the provision of other advisory services; participation in the basic training course in the earth sciences at the University of the South Pacific, which included a four-day cruise; organizing and conducting seminars on precious coral using PEACESAT, in which Dr Richard Grigg of the University of Hawaii participated, and a meeting on the same subject in Tonga; organization of the chartering of the r.v. *Machias*; recruitment of project personnel; and support for the UNDP review mission.
4. A summary was given of the major items of expenditure during the year, particularly the purchase of equipment, mainly using funds provided by Australia. The Group acknowledged with appreciation the further support by the Government of Australia, involving a total contribution of \$A70,000.
5. The Group also expressed its appreciation to the Government of Fiji for the continuing provision of facilities and services for the project, and particularly for the recent provision of a new covered storage area.
6. Thanks were also expressed to the Government of New Zealand for its various contributions, including expert services, equipment, and publication of proceedings.
7. The Group expressed its appreciation of the excellent work carried out by the Technical Secretariat during the period under review.

Review of activities of the ESCAP Secretariat

8. The Group was informed that the ESCAP Secretariat had been concerned mainly with matters relating

to submission of proposals, soliciting of funds and other forms of support, recruitment of staff, and matters relating to ship charter.

9. Although regrettably there were still some payments relating to ship charter in 1977 which had not been finalized, during the year the funds for ship charter had been placed under ESCAP control and the initial payment had accompanied copies of the agreement forwarded to the owner for signature. In addition, every effort would be made to decentralize responsibility as much as possible, not only to ESCAP but to the project office.

Review of survey activities: progress and results

10. The Group noted with appreciation that although the main survey programme had not yet started, members had, with the assistance of the Technical Secretariat, carried out a considerable amount of useful work, as summarized below.
11. Surveys off Rarotonga, Cook Islands, had evaluated bathymetry, precious coral, and sand and gravel.
12. CCOP/SOPAC assistance for Fiji had been concerned primarily with commission of the Mineral Resources Department's r.v. *Bulikula*. Preparations had included selection and training of personnel and installation, evaluation, and testing of equipment.
13. Appreciation was expressed to IOC for funding Mr Tupua's participation in the cruise of the Japanese Geological Survey's ship r.v. *Hakurei Maru*, Tokyo-Suva, 1978.
14. Cruises had been carried out by r.v. *Tangaroa* on regional as well as New Zealand national projects. Phosphorite deposits located on the Chatham Rise had been found to contain some uranium. The material was such that it could be used as a fertilizer without chemical treatment.
15. Further studies were planned which it was hoped would lead to co-operative activities with other member countries.
16. The Papua New Guinea work programme had been revised in co-operation with the CCOP/SOPAC Technical Secretariat, and included:
 - (a) Regional reconnaissance geologic mapping;

- (b) Studies of detrital heavy minerals, including offshore chromite;
- (c) Crustal studies of eastern Papua;
- (d) Inshore surveys.

17. Three surveys had been carried out in Samoa by Technical Secretariat personnel. Precious corals had been sought in two locations, with encouraging results; coralline construction materials were being mined from a near-shore reef at Mulinu'u Point, which could possibly result in coastal erosion; and an Apia Harbour survey, using a 7 kHz reflection system and scuba diving, had been considered to define bottom characteristics for dredging.

18. Solomon Islands projects had also been reviewed and revised. The Group was informed of commercial interest being shown in bauxite on Vaghena and Rennell Islands.

19. Tonga had reported the results of two near-shore studies for precious coral and sand which were undertaken with significant assistance by Technical Secretariat and New Zealand Oceanographic Institute (NZOI) personnel using side-scan sonar and scuba equipment on loan. It was reported that the precious coral surveys had stemmed from the PEACESAT discussions and seminar referred to in paragraph 3 above.

Other activities

20. Cruises by ORSTOM (Office de la Recherche Scientifique et Technique d'Outre-mer) on the CNEXO (Centre National pour l'Exploitation des Océans) ship *r.v. Coriolis* in 1977 and by *r.v. Sonne* (Federal Republic of Germany) in 1978 to obtain additional information on manganese nodules in Cook Islands waters had filled in between surveys undertaken by CCOP/SOPAC and NZOI. CNEXO analyses on ORSTOM cruise samples indicated low Cu, Ni, and Co mean values.

21. The Group expressed appreciation for the services of Mr H. Wittenkindt, made available by the Federal Republic of Germany to Fiji, through ESCAP, for the production of the geological and tectonic maps of the eastern part of the South-west Quadrant of the Circum-Pacific Map Project.

22. Geological mapping of the Fiji islands on the scale of 1:50,000 had been completed. *R.v. Tangaroa* had sampled manganese crusts with high molybdenum values in the Lau Group. Dr D.S. Cronan had reported on the potential of metalliferous muds on the Fiji Plateau. Oil company geothermal prospecting was in progress. Mining activity remained strong, with the

best potential currently in the Namosi area. Detailed aeromagnetic surveys conducted by the United States National Oceanographic and Atmospheric Administration (NOAA) over the Fiji Plateau area indicated a sea-floor spreading pattern. Dr D. Falvey, Sydney University, had worked on paleomagnetic surveys on Viti Levu and on parts of the New Hebrides and New Caledonia which suggested rotation of the Fiji Plateau. LANDSAT data were now being obtained over Fiji when conditions were favourable.

23. The satellite navigator purchased by Fiji for installation on its own cruise vessel had been used on *m.v. Marama* to obtain geodetic positioning in Samoan, Tongan, Fijian, and New Zealand waters.

24. Gravity and refraction studies over the Fiji Plateau by ORSTOM, in co-operation with the University of Texas and NOAA, were reported.

25. A coloured geological map of southern Santo, New Hebrides, at 1:100,000 scale had been published, and the regional report on Efate and Offshore Islands was in press. Copies would be sent to CCOP/SOPAC members in due course. A mineral survey project for base and precious minerals funded under United Kingdom development aid had been initiated in north Santo, and would be extended to Malekula. Approximately 8,000 stream and soil samples would be collected during the project, and would be analysed by the Geological Survey of the Solomon Islands.

26. A major re-evaluation of energy resources had been undertaken in New Zealand, and a Ministry of Energy had been established. With financial support from UNDP, the first of a proposed annual diploma course in geothermal studies would begin in March 1979 at the Geothermal Institute of the University of Auckland. Seventeen out of 25 students (graduates) in each course would be from developing countries, and their costs would be met from UNDP funds.

27. Geological activities in Papua New Guinea included mapping on a scale of 1:100,000 of areas of potential economic interest, reappraisal of the Wau Goldfield and gold mineralization on Woodlark Island, volcano and earthquake monitoring, engineering geology activities, groundwater investigations, geothermal resource investigations, and a regional gravity survey. Mining prospects included porphyry copper, detrital chromite, and gold. One hydrocarbon exploration well had been completed unsuccessfully, and a second was being drilled. Progress in assessment of petroleum exploration data held by the Geological Survey was being hindered owing to difficulties in recruiting suitable professional staff; this, in the view of the Group, was a world-wide problem.

28. Geological mapping in the Solomon Islands continued, with an expectation of completion by 1986. The basic mapping, on a scale of 1:50,000, continued using 75 percent of staff; other activities included hydrological, geothermal, and volcano-seismic studies. Mining prospects included chromite, heavy minerals, possibly porphyry copper, and other base metal deposits. Exploitation of the bauxites on Rennell and Vaghena Islands had not started, but interest continued. Offshore exploration activity was restrained pending enactment of the Petroleum (Production) Ordinance.

29. Other activities in Tonga included an ORSTOM cruise, *Eva III*, using gravimetry and reversed refraction profiling with ocean bottom seismometers (OBS). Paleomagnetic studies of paleogene deposits in Eua Island by Dr D. Falvey, University of Sydney, were part of ongoing studies relating to island arc tectonics.

30. In Samoan waters, during an ORSTOM cruise, r.v. *Coriolis* had worked on bathymetric surveys and on establishment of geodetic fix. Proposed energy developments in Samoa included hydroelectricity on Upolu and thermal power on Savai'i using waste wood as fuel, with funding from UNDP and the United Nations Capital Development Fund (UNCDF). Work by Apia Observatory included promotion of an emergency information service, the improvement of communication links to provide 24-hour service, and development of a tsunami warning link to Hawaii.

31. A number of United States governmental and non-governmental bodies had been active in surveys in the area. Work was continuing on the Circum-Pacific Map Project, preparing a series of 1:10 million scale maps encompassing the CCOP/SOPAC region, including data on bathymetry, geology, tectonics, geodynamics, and hydrocarbon and mineral resources. Collaborative work by the University of Texas, Cornell University, ORSTOM, and the New Hebrides Mineral Resources Department had produced numerous refraction profiles, and led to the establishment of land stations and OBSs to monitor volcanic and seismic activity in the New Hebrides. The Group noted with appreciation that the United States Geological Survey had agreed to provide the services of an electronics technician for six weeks in 1979. The United States Government had also approved the grant of \$100,000 worth of seismological equipment to be used to monitor activity along an active seismic zone in Fiji.

32. The Group expressed strong concern at the general absence of implementation of comprehensive international scientific programmes in the CCOP/SOPAC region as recommended by the 1975

International Decade of Ocean Exploration (IDOE) workshop at Suva. For instance, past international research suggested that the unique setting of the Melanesian borderland, the Fiji Plateau, and the peripheral active margins might become classic areas for the study of crustal and mantle rheology. The Group urged international funding bodies to increase their level of support to scientific research projects in the CCOP/SOPAC region.

33. Information was provided on USSR cruise studies over the past decade, including eleven expeditions. Those expeditions had been conducted under the auspices of national projects as well as the international upper mantle project and the International Geological Correlation Programme (IGCP) ophiolite project. The data obtained on those cruises were available through World Data Centre B. The Group noted with appreciation the availability of bathymetric and gravity maps of the Pacific and Antarctic areas and a paper on oil-gas possibilities of Pacific marginal seas compiled by Soviet scientists. The USSR was also co-operating with IOC in the compilation of a Pacific geological-geophysical atlas. To facilitate that work the Group recommended that member countries forward relevant material to the editor, Professor G.B. Udintsev, through IOC, for inclusion in the atlas. The representative of the USSR noted with appreciation the considerable contribution to the atlas made by New Zealand with the submission of detailed bathymetric maps. He also indicated the possibility of participation in seismicity and earthquake prediction programmes in the CCOP/SOPAC region.

34. The Observer from Norway informed the Group that he had been so appointed by his Government, and was associated with Det Norske Veritas (DNV), whose direct concern was marine safety and pollution. The Group expressed its appreciation to the Government of Norway for sending an observer to the session. The availability of services at cost from DNV on matters relating to safety and environment, and the possibility of advisory services from Norway, particularly in mapping, oil data collection and storage, exploration administration, and data analysis, were noted with appreciation. Attention was drawn to the need to specify fields in which advice would be needed.

35. France, through ORSTOM, had been involved in a variety of activities in co-operation with member countries and with other bodies, as reported above.

36. Australia hoped to obtain a civilian ocean-going research vessel by 1981. Current offshore work by the Bureau of Mineral Resources, largely in co-operation with Woods Hole Oceanographic Institute, Lamont-Doherty Geological Observatory, and the Bundesan-

stalt für Geowissenschaften und Rohstoffe, using r.v. *Sonne*, included studies of the Lord Howe Rise, Coral Sea, and Great Barrier Reef.

37. The United Kingdom was continuing to provide specialized personnel to Fiji, the Solomon Islands, and the New Hebrides. The Group expressed its appreciation for assistance provided by Dr Cronan, whose mission was funded by IOC.

38. SPEC activities included co-ordination of European Economic Community (EEC) aid for regional projects, law of the sea, environment, and a fellowship training scheme. The observer from SPEC invited countries to make use of the scheme in their training programmes.

39. The representative of IOC advised that the recommendation of the sixth session of CCOP/SOPAC expressing the Committee's willingness to co-operate closely with the new IOC subsidiary body for the Western Pacific region (WESTPAC) had been reflected in IOC resolution X-II, which included the following two paragraphs:

Welcomes the invitation of CCOP/SOPAC to IOC to co-operate closely with WESTPAC in the fields of marine geology and geophysics and related activities in CCOP/SOPAC region, through a joint mechanism;
and

Recommends that the countries within the various subregions of the WESTPAC, such as those of the South Pacific and the East Asian regions, formulate their own subregional programmes in consultation with co-operating countries from outside the subregion.

40. The Group was also advised that a WESTPAC Working Group meeting was scheduled to be held at Tokyo from 21 to 24 February 1979, preceded by a two-day workshop. It was expected that those meetings would determine priorities for activities, which should be based on the needs of the countries. It was noted that an outline, recommended by an *ad hoc* working group at Noumea in June 1977, had already been approved by IOC.

41. Having regard to the fact that CCOP/SOPAC was an intergovernmental body responsible for planning and carrying out a co-ordinated programme of geological and geophysical studies in the areas of interest to its members, which covered much of the South-west Pacific, the Group recommended that the WESTPAC Working Group meeting at Tokyo be informed (preferably by Mr R.N. Richmond of Fiji assisted by Dr R.A. Heath of New Zealand) that CCOP/SOPAC:

(a) Accepted the co-ordination role for marine geological, geophysical, and related programmes in the CCOP/SOPAC region;

(b) Suggested that the Western Pacific region, as defined in IOC/WESTPAC *Ad Hoc* 1/3, be enlarged to include the full CCOP/SOPAC region, including in particular the Cook Islands;

(c) Invited WESTPAC representatives to attend the next CCOP/SOPAC session;

(d) Invited IOC to arrange for an appropriate workshop/symposium at the ORSTOM Centre in Noumea in 1980, with a view to identifying a joint CCOP/SOPAC-WESTPAC programme for consideration and approval at the CCOP/SOPAC meeting, and further endorsement by WESTPAC, taking into account the programme developed at the 1975 IDOE workshop at Suva;

(e) Noted that individual projects to be implemented partly or fully within areas under the jurisdiction of a State should be carried out only with the authorization of the State concerned.

42. The Group was also informed of the interest of IOC in environmental matters, particularly pollution research and monitoring. Several publications were available, including an Integrated Global Ocean Station System (IGOSS) publication on monitoring for petroleum, an overview of global marine pollution, and a prospectus on pollution in the marine environment. Technical advisory services could also be made available if requested. The Group agreed that more detailed consideration might be given to the matter after a marine scientist had been recruited and had taken stock of the situation.

43. The Group noted that SPEC, in consultation with the South Pacific Commission (SPC), was developing a plan of action for a regional environmental programme for consideration by respective member countries and territories.

Data and information management

44. The Technical Secretariat reported on development of arrangements to liaise through the Hawaii Institute of Geophysics (HIG) to World Data Centre A. Based on the needs expressed at the sixth session, HIG had approached the United States Sea Grant programme to determine interest in sponsoring that type of project. Sea Grant had responded by paying the cost of travel of a representative to the seventh session to determine the detailed needs of CCOP/SOPAC. The Group noted with appreciation that it was likely that a two-year project would be approved, to start in January 1979 and to include a training programme for member country personnel.

45. The Group was advised that World Data Centre B was interested in establishing direct data exchange with CCOP/SOPAC.

46. The Group was informed of developments in data management under the auspices of IOC, which included World Data Centres A and B. A number of countries in eastern Asia and the South Pacific had established national data centres or designated national agencies as part of International Oceanographic Data Exchange (IODE). Tape formats, including formats for geological and geophysical data, had been adopted and would be reviewed in January 1979. A manual on data exchange, a guide on national data systems, and a brochure on activities in that field were available.

47. In considering CCOP/SOPAC interests in that field, it was agreed that, having regard to limitations of facilities and resources, the project should make maximum use of facilities and services available elsewhere, particularly in Hawaii, Australia, and New Zealand. A regional data centre was not warranted, but an inventory of data availability and sources would be very desirable. In that connexion, the Group noted with appreciation advice from the Technical Adviser from France that it was hoped that his Government would be able to provide CCOP/SOPAC with the services of a geoscientist in 1979 to collate available information in the project area.

48. The Group was also informed that the Paris School of Mines had a data bank on manganese nodules with some 20,000 analyses on magnetic tape, the information on which would be provided at cost. Data had been published in 1975, and a new publication was proposed for 1979, in co-operation with the United States Geological Survey.

CCOP/SOPAC publications

49. The Technical Secretariat reported on the status of publications: two more issues of *South Pacific Marine Geological Notes* had been published, three were in press, and four in preparation. The New Zealand representative advised that *Proceedings of the Sixth Session*, advance copies of which had been made available to participants in the seventh session, would be published shortly.

Training: programmes and requirements

50. The first basic earth sciences course had been held successfully at the University of the South Pacific, with support from the Technical Secretariat. Provisional costings for future courses had also been provided.

51. Members reported favourably on the value of the course, which had increased the confidence as well as the competence of the trainees. Steps were being taken

to encourage some trainees to proceed to university, but the Group agreed that the course was valuable in training technicians as such.

52. With regard to the nature of future courses, the Group agreed that the next course should be a basic earth science course similar to the first, and that more advanced training might best be handled on an individual basis. Consideration could be given to the provision of such training in existing institutions, such as NZOI. The Group noted that funds to support attendance at the proposed earth science course might be obtainable from IOC/UNESCO, and through the SPEC fellowship scheme, in addition to those from UNDP provided for in the project document. The Group noted with appreciation the provision of \$A18,000 by the Government of Australia towards the cost of the last course, and the advice that similar support might be provided for the next course.

53. The Group stressed the value of training on survey cruise vessels, and noted with appreciation the likelihood of such opportunities on vessels operated by France, Japan, New Zealand, the USSR, and the United Kingdom. As regards Japan and the USSR, arrangements were normally made through ESCAP, and in any case countries were requested to give the necessary advice as far in advance as possible, to facilitate appropriate arrangements. The Group noted with appreciation that IOC might be able to provide funds to enable trainees, particularly those from IOC members, to travel to and from ports of embarkation and disembarkation.

54. The USSR was also willing to provide training at land-based institutions under the UNESCO fellowship programme. NZOI would consider favourably applications for training for three- to six-month courses (including sea time) for one or two persons per year from member countries. The Group expressed its thanks for those offers.

55. The representative of IOC drew the attention of the Committee to the IOC Voluntary Assistance Programme (VAP), which was entirely dependent on voluntary contributions made by IOC member States in response to requests for assistance made to IOC by other member States. Contributions might be in the form of funds, equipment, or the offer of services. Assistance might take the form of training of personnel; support of the development of marine science organizational structures, research laboratories, or educational facilities; information on technology for the exploitation of marine resources; and the advice of visiting experts in training, education, and technology related to the marine sciences. IOC-VAP was similar to WMO-VAP, which had operated successfully for many years.

56. The Group agreed that CCOP/SOPAC should accept an invitation to co-sponsor meetings on phosphates at Honolulu in 1979 and 1980. However, having regard to the likely limited participation of member countries, it was decided not to co-sponsor the seminar on subsurface exploration methods for sedimentary basins, scheduled for February 1979 at Manila. Nevertheless, the Group felt it would be advantageous for a member of the Technical Secretariat to attend the Manila meeting. It was noted that Papua New Guinea might send one or two people to that meeting.

Advances in technology for exploration and development of marine mineral resources

57. The Observer from Norway reported on research and developments in relation to safety evaluation and management of offshore engineering activities.

58. The Technical Adviser from the United Kingdom reported on further developments in the sea-bed spectrometer involving the use of neutron activation techniques, a diver-activated suction pump which had proved useful for clearing shallow overburden, and a cable-controlled TV vehicle called "Smartie".

59. The Group was advised of United States satellite programmes of significance to marine geoscience, as follows:

- (a) LANDSAT images from the multispectral scanner in four spectral bands (since 1972) could be subject to a principal-component analysis of colour composites, permitting easy differentiation of land, reefs, and shallow and deep water from the reflection or relative density of each colour;
- (b) LANDSAT images could be combined with contoured magnetic anomalies such that the parallax effect gave a stereo version of the anomalies on the ground patterns;
- (c) Systems on LANDSAT could collect data from up to 1,000 platforms, each with eight sensors. Beginning in 1972, the United States Geological Survey had been routinely monitoring 15 volcanoes in Central and North America. Stored data were transmitted to LANDSAT about every 12 hours from (i) seismic-event counters on all 15 volcanoes — a major increase in seismicity preceded one eruption; and (ii) tiltmeters installed in 3-metre holes at six volcanoes — a tilt of from 20 to 150 microradians preceded three eruptions. Such instrumentation (at about \$5,000 per instrument) provided both scientific and humanitarian benefits;
- (d) GEOS 3 (since 1975) had a radar altimeter permitting 1-metre contouring of the geoid over major water bodies; SEASAT (launched in June 1978) had an altimeter permitting 10-cm geoid determinations;

(e) LAGEOS (since 1970) made precise measurements ($20 \text{ mm} \pm$) over long distances, such that relative motions between land masses could be quantified;

(f) MAGSAT (planned for September 1979) would have scalar accuracy of $3 \pm$ gammas; it would assist in updating the magnetic field, anomalies, and models.

60. The Technical Adviser from the University of Hawaii reported that a manganese nodule processing pilot plant was under construction in Hawaii, with refining to start early in 1979. Further information on the matter would be provided to CCOP/SOPAC.

61. The Australian Technical Adviser reported that BMR had recently developed a simple submersible rotary drill system costing about \$5,000. The drill took a $2\frac{1}{8}$ inch core in 3-foot lengths, and was hydraulically powered by an 8 hp petrol engine and a heavy-duty pump. The drill head weighed about 150 lb and the power system about 500 lb, and the whole could be readily transported in a small boat. It could drill from a tripod in shallow water, or be manhandled by divers for drilling in deeper water, including reef slopes. Penetration exceeded 18 m, and recovery of up to 95 percent had been obtained in recent drilling on the Great Barrier Reef.

62. The Group noted the development of a nitrate fertilizer generator and a submersible scintillometer.

Evaluation of resources and their significance

63. The Group expressed its appreciation of the efforts of Dr H.R. Katz in reporting on the petroleum developments in the South-west Pacific on behalf of CCOP/SOPAC, and hoped that he would continue his valuable service.

64. Developments in hydrocarbon exploration and exploitation in New Zealand were reported. Other New Zealand offshore resources were reported.

65. The representative of Fiji described petroleum developments. He referred to the likely interest of Fiji in offers of technical assistance by Norway and by New Zealand in matters concerning safety, inspection, and management in connexion with prospective offshore drilling operations.

66. The representative of Tonga expressed appreciation to Dr L. Kroenke and Dr H.R. Katz for their work in reviewing existing data associated with petroleum prospects.

67. The Group noted current developments on manganese nodules and precious corals. With regard to the report of the United Nations Group of Experts Meeting on Sea-bed Mineral Resources Assessment, held in New York from 28 November to 1 December 1977, the Technical Adviser from France advised that a French consortium was also active in that field.

Report on energy developments

68. The Technical Secretariat reported on ocean thermal energy conversion (OTEC). The Group was informed that three possible OTEC installations were programmed in Hawaii: a 50-kW "mini-OTEC", a 1-MW unit, and its pilot plant, to be installed on floating barges.

69. The Group noted that, having regard to the high cost of using low-grade heat on land, it was unlikely that OTEC, involving the use of a small temperature differential at sea, would be economically attractive under South Pacific conditions in the near future.

Reports on developments relating to the law of the sea

70. The Group was advised that the Fiji Government had declared archipelagic baselines and internal 12 nautical mile waters in April 1978. New Zealand had declared a 200 nautical mile Exclusive Economic Zone (EEZ), which had come into effect in April 1978.

71. It was also noted that SPC had programmed a workshop during the current year at Noumea on the implications of a 200 nautical mile EEZ.

Consideration of the report of the UNDP technical review mission

72. Member countries expressed their appreciation to UNDP for the expeditious fielding of the technical review mission, which, in spite of early misgivings concerning the short notice, had concluded its work and completed its report quickly and efficiently. The findings of the review mission largely corroborated and endorsed the findings of the 1975 technical mission, and contained some significant additional proposals.

73. With regard to the petroleum symposium proposed for 1979, it was agreed that participation should be such as to bring together from all over the world specialists with experience relevant to conditions in the project area. Interest was expressed in the concept of a revolving fund to stimulate petroleum exploration in the area, and it was noted that UNDP might obtain additional funds, for instance from the Organization of Petroleum Exporting Countries (OPEC), to initiate such a proposal.

74. The Technical adviser from France endorsed the value of the proposed petroleum symposium and of the meeting on the 200 nautical mile EEZ, and indicated that France was likely to participate in both meetings.

Review of the draft project document in the light of the review mission's recommendation

75. In considering the draft project document, representatives of member countries expressed their appreciation for the assurance it offered of support for a substantial programme over the next three years.

76. With regard to the proposed cash contribution, member countries strongly supported the principle of a regional cash contribution to be used to train regional staff to form the nucleus of such intergovernmental institutions as might be appropriate.

77. It was noted that the programme attached to the project document required flexibility, since:

- (a) Some member country work programmes required substantial modification, which would affect others;
- (b) Programme priorities would change, and would be subject to review at CCOP/SOPAC sessions;
- (c) Marine surveys were liable to modification owing to unforeseen circumstances.

78. The UNDP representative stated that if additional countries become signatories to the project, and that resulted in demands beyond the capacity of the project inputs included in the current document, a revision providing for additional finance could be considered by UNDP, subject to the availability of funds.

79. The Group proposed a number of amendments to the draft project document, and recommended it for signature by the participating countries.

Review of the terms of reference of CCOP/SOPAC

80. An outline was given of the review by the United Nations office of Legal Affairs concerning the relative status of and relationships between the United Nations and inter-country bodies established under its auspices.

81. It was suggested that consideration be given to the scope of the Committee's interests as set out in the terms of reference, having regard, for instance, to the activities relating to the environment and proposed studies on shore, as set out in the project document. There was also scope for removal of some anomalies and for tidying up the document's presentation.

82. The Group requested the ESCAP Secretariat to prepare and distribute proposals for amendment of the terms of reference as soon as possible, with a view to determination of the matter at the following session.

83. In that connexion, the question was raised of institutional arrangements arising from the decision to provide cash contributions for recruitment of regional staff additional to the project staff. Reference was made to other instances of the same general nature, such as that of the recently established Southeast Asia Tin Research and Development Centre, and ESCAP was requested, as a matter of urgency, to prepare a proposal that might be suitable for SOPAC countries, and to submit it for consideration. The aim was the establishment of an intergovernmental body with its own legal entity, including capability to engage staff and receive direct assistance.

84. Reference was also made to the question of languages to be used in conducting the business of the Committee and Group. While it was recognized that French was commonly used within the Pacific region, and it was noted that French and Russian would be used as well as English in WESTPAC, it was also recognized that there were substantial costs involved in adding other languages to English as official languages of the Committee.

85. It was agreed that the ESCAP Secretariat should be asked to provide a summary of the report and recommendations of the Committee and of TAG in French and Russian as well as English as soon as possible after each session.

Formulation of the work programme

86. The Technical Secretariat introduced and explained the project data sheets and the project status reporting sheets.

87. Several member countries stressed the importance of bathymetric investigations. It was agreed that they were not part of the UNDP project, and that other funding for them should be sought. The Technical Secretariat was requested to define ship time and funding requirements for such studies. The Group noted with appreciation offers from France, Australia, and New Zealand to consider sympathetically any requests for assistance with that work.

88. It was stressed that the focus of the mineral objectives might change as more information was obtained in the surveys. For instance, the Fiji, Papua New Guinea, and Solomon Islands programmes had been planned with the intention of defining resource-related objectives for further study.

89. The Technical Secretariat detailed the provisional work programme for r.v. *Machias* for the remainder of 1978. The Group approved the cruise programme, and noted the possibility that it might extend into 1979 under the new project.

90. NZOI outlined their prospective cruises of interest in the region. Requests for work to be carried out in 1980 would be considered if received by September 1979. Member countries should correspond directly with NZOI with regard to the r.v. *Tangaroa* programme. NZOI intended to search for phosphates northward into the project area under the direction of Dr Cullen, probably in 1980.

91. The Group was interested to learn that New Zealand had recently commissioned the hydrographic vessel HMNZS *Monowai*, which might be available for up to two months' work each winter in the CCOP/SOPAC area, particularly on coastal and harbour surveys. Requests for work by *Monowai* in that period should be made directly to the New Zealand Government through the respective Department of Foreign Affairs or corresponding government agencies.

Adoption of the report

92. The Technical Advisory Group adopted its report on 13 October 1978.

Summary of conclusions and recommendations

93. The Technical Advisory Group:

1. Expressed strong concern at the general absence of comprehensive international scientific programmes in the region, and urged funding bodies to increase their level of support to research projects (para. 32).
2. Recommended that member countries forward relevant material to the USSR for inclusion in a Pacific geological-geophysical atlas (para. 33).
3. Recommended that the WESTPAC Working Group meeting be informed that CCOP/SOPAC:
 - (a) Accepted the role of co-ordinator;
 - (b) Suggested that the Western Pacific region, as defined by IOC/WESTPAC, be enlarged;
 - (c) Invited IOC to arrange for a workshop in 1980;
 - (d) Noted that projects implemented within areas under the jurisdiction of a State be carried out only with the authorization of that State (para. 41).
4. Agreed that more consideration might be given to environmental matters after a marine scientist had been recruited (para. 42).

5. Agreed that a regional data centre was not warranted, but that an inventory of data availability and sources would be desirable, and that the project should make maximum use of facilities and services elsewhere (para. 47).
6. Agreed that the first basic earth science course was valuable, that the next course should be similar to the first, and that more advanced training might best be handled on an individual basis (paras 51, 52).
7. Stressed the value of training on survey vessels and, to facilitate arrangements, requested countries to give the necessary advice in advance (para. 53).
8. Agreed that CCOP/SOPAC should accept an invitation to co-sponsor a meeting on phosphates but not a seminar on subsurface exploration methods (para. 56).
9. Hoped Dr H.R. Katz would continue reporting on petroleum developments in the South-west Pacific (para. 63).
10. Agreed that the petroleum symposium should bring together specialists with experience relevant to conditions in the project area (para. 73).
11. Proposed a number of amendments to the draft project document, and recommended it for signature (para. 79).
12. Requested ESCAP to prepare and distribute proposals for amendment of the terms of reference (para. 82).
13. Agreed that ESCAP should be asked to provide a summary of the report and recommendations in French, Russian, and English (para. 85).
14. Agreed that bathymetric investigations were not part of the UNDP project, and that other funding should be sought for those studies (para. 87).
15. Stressed that the focus of mineral objectives might change as more information was obtained (para. 88).
16. Approved the cruise programme for 1978 (para. 89).

ANNEX II

WORK PROGRAMME

The work programme is defined on Project Data Sheets which are kept on file at the CCOP/SOPAC Technical Secretariat. Changes to this programme and advances made on individual projects are given below under the following headings.

- (a) Proposal and/or Revision: identifying those TAG sessions at which these were made. Details of new projects and project revisions are given as follows -
 - (i) Background Information
 - (ii) Project Objectives
 - (iii) Economic Target
 - (iv) Relationship of Project to Mineral Development Policy
 - (v) References
- (b) Planning: work which needs to be done before the main part of the survey work
- (c) Preparations: preparatory work being carried out or completed
- (d) Field Operations: survey work being carried out or completed
- (e) Reports: unpublished documents
- (f) Publications: published papers
- (g) Final Recommendations: recommendations made on completion of the project
- (h) Application of Results

The categories of priorities used are: "A" - very important, early performance desirable; "B" - scientifically and economically important.

COOK ISLANDS

CCSP-1/CK.1: Sea-bed investigation for manganese nodules and crusts in oceanic areas adjoining Cook Islands (Priority A).

- (a) *Proposal*: see TAG-II.
- Revision*: as follows.

- (i) **BACKGROUND INFORMATION.** Considerable information on manganese nodule occurrence and distribution in the Cook Islands area has been gathered on French, German, New Zealand, and Russian research cruises and on CCOP/SOPAC surveys. Density distribution and metal content are variable. Further sampling

remains to be done in areas where metal content is highest, and where few or no samples have been collected. Manganese nodule programmes recommended for the Cook Islands by the CCOP/SOPAC - IOC IDOE International Workshop (1975) are as follows:

Field Project 3-1: Manganese nodules and crusts on the Manihiki Plateau.

Field Project 3-3: Manganese nodules in basins along a transect between the Cook Islands and the Tuamotu Archipelago.

- (ii) **PROJECT OBJECTIVES.** To determine the distribution of manganese nodules in the Cook Islands region and establish the density of nodules present and metal content in order to evaluate their economic potential. This study includes both deep basin nodule deposits and crust deposits typically found on bathymetric highs such as seamounts, ridges, and plateaus.
- (iii) **ECONOMIC TARGET.** To establish nodule density (quantity per unit area) and quality (metal content, especially Cu, Co, and Ni) in order to establish the economic potential of Cook Islands offshore manganese nodule deposits.
- (v) **REFERENCES**

BACKER, H.; GLASBY, G.P.; MEYLAN, M.A. 1976: Manganese nodules from the Southwestern Pacific Basin. *NZOI oceanog. Fld Rep.* 6: 88 pp.

BEZRUKOV, P.L., 1971: The main scientific results of the 48th voyage of the R/V Vityaz in the Pacific Ocean. *Oceanology* 11: 457-63.

GLASBY, G.P. 1976: Manganese nodules in the South Pacific: a review. *N.Z. J. Geol. Geophys.* 19(5): 707-36.

LANDMESSER, C.W.; KROENKE, L.W.; GLASBY, G.P.; SAWTELL, G.H.; KINGAN, S.; UTANGA, E.; UTANGA, A.; COWAN, G. 1976: Manganese nodules from the South Penrhyn Basin, Southwest Pacific. *S. Pacif. mar. geol. Notes* 1(3): 17-40.

MEYLAN, M.A.; BACKER, H.; GLASBY, G.P. 1975: Manganese nodule investigations in the Southwestern Pacific Basin, 1974. *NZOI oceanog. Fld Rep.* 4: 24 pp.

MEYLAN, M.; GLASBY, G.P.; McDOUGALL, J.C.; SINGLETON, R.J. 1978: Manganese nodules and associated sediments from the Samoan Basin and passage. *NZOI oceanogr. Fld Rep.* 11: 61 pp.

MONZIER, M.; MISSEGUE, F. 1977: Polymetallic nodules sampling in the Cook Islands archipelago. Preliminary report. OR-STOM-CNEXO.

For further references see:

GLASBY, G.P.; HUBRED, G.L. 1976: Comprehensive bibliography of marine manganese nodules. *Mem. N.Z. oceanogr. Inst.* 71: 55 pp.

- (b) *Planning*: Compile a list of sediment stations with list of manganese nodule data for Cook Island region.
- (c) *Preparations*: Survey time to investigate manganese nodules in Penrhyn Basin is programmed for November 1978.
- (f) *Publications*: GLASBY, G.P. 1978: Notes on the surface texture, internal structure and mineralogy of manganese nodules from the South Penrhyn Basin. *S. Pacif. mar. geol. Notes* 1(7): 71-80.

CCSP-1/CK.2: Distribution and economic potential of submarine phosphate deposits in Cook Islands waters (Priority A).

- (a) *Proposal*: see TAG-IV.

Revision: as follows.

- (i) **BACKGROUND INFORMATION.** Submarine deposits of phosphate and phosphorite have been found on seamounts in the Indian Ocean (Bezrukov 1973). Small high-grade deposits of guano-derived phosphate rock occur on a few islands in the South Pacific (e.g., Nauru and Ocean Island). Guano deposits may have accumulated on other former islands which are now submerged.

Phosphorite deposits may occur on ridges, seamounts, and other topographic highs, especially where there is oceanic upwelling. Ideal circumstances for the formation of offshore phosphorites in the Southwest Pacific would comprise: (1) an elongate topographic high lying at right angles to the prevailing current; (2) a sufficient depth to prevent coral growth (>50 m) but not so deep as to make mining prohibitively expensive; (3) deeper waters which will be older than normal; (4) upwelling which may have been noted in the area; (5) high organic productivity; and (6) the presence of guano deposits in the vicinity.

- (ii) **PROJECT OBJECTIVES.** To search for submarine phosphate deposits, and to establish the size and grade of each discovery.

- (iii) **ECONOMIC TARGET.** Evaluate the potential of submarine phosphate deposits.

- (v) **REFERENCES**

BEZRUKOV, P.L. 1973: Principal scientific results of the 54th cruise of the R/V Vityaz in the Indian and Pacific Oceans (February-May 1973). *Oceanology* 13(5): 921-26.

COOK, P.J. 1975: Prospects for finding offshore phosphate deposits in the Southwest Pacific. Pp. 75-85 in ANON, The Proceedings of the Third Session of CCOP/SOPAC, Apia, Western Samoa, September 1974.

- (b) *Planning*: Review of bathymetric data and selection of seamounts and ridges where phosphate may occur.

CCSP-1/CK.3: Investigation for precious coral in the nearshore waters surrounding the Cook Islands (Priority B).

- (a) *Proposal*: see TAG-V.

Revision: as follows.

- (i) **BACKGROUND INFORMATION.** Precious corals (pink, black, and other types) may occur in the Cook Islands and be present in quantities sufficient to provide material for a jewel coral industry. Efforts to find precious corals will concentrate on the deeper-water pink corals (*Corallium*) which are known to occur in Samoa. They are commonly found on rocky bottoms between 100 and 500 metres where currents are strong. Large beds will be found only where the bottom is not steeply sloping.

- (ii) **PROJECT OBJECTIVES.** To find precious coral beds (primary interest is *Corallium* species) and evaluate their resource potential.

- (iii) **ECONOMIC TARGET.** To establish whether there is sufficient *Corallium* and other precious corals in Cook Island waters on which to base a precious coral industry.

- (v) **REFERENCES**

GRIGG, R.W. 1971: Status of the precious coral industry in Japan, Taiwan and Okinawa. 1970 Sea Grant Advisory Report UNIHI-SEA-GRANT-AP-71-02: 12 pp.

GRIGG, R.W. 1976: Fisheries management of precious corals in Hawaii. *Sea Grant Tech. Report UNIHI-SEAGRANT-TR77-03*: 48 pp.

- (b) *Planning*: Review bathymetric data and select potential areas for sampling.

- (c) *Preparations*: Survey time is programmed for November 1978.

CCSP-1/CK.4: Study of sediments and sedimentary processes of beach, lagoon, and adjacent offshore areas of Rarotonga and other islands to assist with coastal management programmes (Priority A).

- (a) *Proposal*: see TAG-VI.

Revision: as follows.

- (i) **BACKGROUND INFORMATION.** Beaches and lagoons in the Cook Islands, especially Rarotonga, have been a source of sand for landfill and construction purposes. Future mining of sand and other planned coastal activities require an understanding of beach and lagoon processes that control sediment supply, transportation, deposition, and erosion.

- (ii) **PROJECT OBJECTIVES.** To build up a detailed knowledge of beach, lagoon, and adjacent offshore environments, including the sediments, their source and distribution, and the processes controlling their distribution.

To establish the extent to which sand mining and other alterations to the coast may be developed without adversely affecting the coastal environment.

- (iii) ECONOMIC TARGET. Proper coastal management.
- (v) REFERENCE. (Some carbonate sand and gravel samples from Rarotonga were tested for their suitability as aggregate in cement by the N.Z. Concrete Research Association, DSIR, and found to be unsuitable.)
- (b) *Planning*: Review existing data and establish long-term plans for coastal development in the Cook Islands.
- (d) *Field Operations*: Rarotonga nearshore survey (CK.78-1).
- (e) *Reports*: Document NR/CCOP/SOPAC(7)/CR.5.

CCSP-1/CK.5: Bathymetric mapping of the Cook Islands (Priority A).

- (a) *Proposal*: (new project).
 - (i) BACKGROUND INFORMATION. A set of provisional bathymetric maps for the southern Cook Islands was first produced by N.Z. Oceanographic Institute between 1966 and 1969. Since then considerable raw bathymetric data has been collected in Cook Islands waters by scientific expeditions.
 - (ii) PROJECT OBJECTIVES. To produce a series of detailed bathymetric charts for all islands in the Cook group on a scale of 1:200,000.
To update existing smaller-scale bathymetric maps of the Cook Islands (i.e., 1:1,000,000 and 1:5,000,000).
 - (v) REFERENCES
 SUMMERHAYES, C.P.; KIBBLEWHITE, A.C. 1966: Aitutaki Provisional Bathymetry. *N.Z. oceanogr. Inst. Chart, Island Ser. 1:200,000*.
 SUMMERHAYES, C.P.; KIBBLEWHITE, A.C. 1968: Atiu Provisional Bathymetry. *N.Z. oceanogr. Inst. Chart, Island Ser. 1:200,000*.
 SUMMERHAYES, C.P.; KIBBLEWHITE, A.C. 1968: Mangaia Provisional Bathymetry. *N.Z. oceanogr. Inst. chart, Island Ser. 1:200,000*.
 SUMMERHAYES, C.P. 1968: Manuae Bathymetry. *N.Z. oceanogr. Inst. chart, Island Ser. 1:200,000*.
 SUMMERHAYES, C.P.; KIBBLEWHITE, A.C. 1969: Mauke Provisional Bathymetry. *N.Z. oceanogr. Inst. chart, Island Ser. 1:200,000*.
 SUMMERHAYES, C.P.; KIBBLEWHITE, A.C. 1967: Rarotonga Provisional Bathymetry. *N.Z. oceanogr. Inst. Chart, Island Ser. 1:200,000*.
 SUMMERHAYES, C.P. 1969: Rarotonga Bathymetry. *N.Z. oceanogr. Inst. Chart, Oceanic Ser. 1:1,000,000*.
 SCRIPPS INSTITUTION OF OCEANOGRAPHY 1973: Bathymetry of the South Pacific. *Chart No. 13*.

- (b) *Planning*: Accumulate latest data from various repositories.

FJI

CCSP-1/FJ.1: Assessment of hydrocarbon potential of north-west Fiji about Bligh Water (Priority A).

- (a) *Proposal*: see TAG-I.

Revision: as follows.

- (i) BACKGROUND INFORMATION. Revised project incorporates former projects CCSP-1/FJ.1 (*Stratigraphic test drilling, northern margin of Fiji Shelf*) and CCSP-1/FJ.3 (*Re-evaluation of seismic and other data available on relinquished petroleum concession west of the Yasawa Group*).
With the establishment of a new lease of Fiji Petroleum Concession A (Bligh Water) to Pacific Energy and Minerals Limited and MAPCO, deep seismic data from Concession Areas A (Bligh Water), B (Yasawa Shelf), and F (Yandua Shelf) have been reprocessed and further studies made of magnetic, bathymetric, and geothermal data. Further geophysical work is planned for 1978-79 over Areas A, B, D (Lomaiviti Shelf; under licence to Dakota Exploration), and F, and drilling from a semi-submersible rig should commence August 1979.
- (ii) PROJECT OBJECTIVES. Monitoring and assessment of presently held and incoming data relating to hydrocarbon exploration by oil companies in Bligh Water and over surrounding shelves, including from planned boreholes, by CCOP/SOPAC petroleum consultant.
- (iii) ECONOMIC TARGET. Potential resource assessment by monitoring of hydrocarbon exploration by oil companies.
- (iv) RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY. Crucial to Fiji Government energy policy.
- (b) *Planning*: Assessment of existing technical data to be done by CCOP/SOPAC petroleum consultant. This project incorporates former project CCSP-1/FJ.3.
- (d) *Field Operations*: Surveys by oil company crews are in operation, and drilling is expected to start in 1979.

CCSP-1/FJ.1A: (Deleted and transferred to CCSP-1/FJ.15).

CCSP-1/FJ.1B: (Deleted and transferred to CCSP-1/FJ.15).

CCSP-1/FJ.3: (Deleted and transferred to CCSP-1/FJ.1).

CCSP-1/FJ.4: Offshore geological mapping of the shallow shelves surrounding Bligh Water (Priority B).

- (a) *Proposal*: see TAG-VII.

Revision: as follows.

- (i) **BACKGROUND INFORMATION.** A reconnaissance mapping programme in these shelf areas, using r.v. *Bulikula* over the decade from 1979, is described in the references below. Drying ground, reefs, and islets will also be examined. The oil companies holding the lease on Bligh Water intend to charter *Bulikula* for surveys within this area to assist their own geophysical and drilling vessels.
- (ii) **PROJECT OBJECTIVES.** To identify by reconnaissance surveys such mineral resources as may exist in depths which would allow presently feasible exploitation, leading to more detailed surveys under specific future projects covering particular deposits.
- (iii) **ECONOMIC TARGET.** To be defined as surveys progress.
- (iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY.** Basic research to allow assessment of resources within one-third of the surface area of Fiji's territory - this area includes all offshore regions where the sea floor is at less than 200 metres depth.
- (v) **REFERENCES**
NR/CCOP/SOPAC(6)CRS.32(B) and 35.
- (b) **Planning:** Geophysical surveys to be carried out by oil companies using new Fiji MRD(O) vessel r.v. *Bulikula*, to start 1979; other surveys, including mapping of those areas, to be carried out by MRD.

CCSP-1/FJ.5: Sea-bed sampling for phosphorites in the Lau Group (Priority B).

- (a) **Proposal:** see TAG-I.
- (i) **BACKGROUND INFORMATION.** Though the detailed bathymetry of the area is little known, and will require much of the preliminary work devoted to this project, indications exist that conditions favourable to past and present phosphate formation as guano and sea-bed phosphorites pertain. Seamounts with top depths from 50 to 100 metres, where feasibly recoverable deposits might be found, are known to exist, and some deposits are already located and assessed on the islands themselves.
- (ii) **PROJECT OBJECTIVES.** Location and assessment of submarine phosphate deposits.
- (iii) **ECONOMIC TARGET.** Assessment of mineral resources.
- (iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY.** In line with Fiji Government objectives.
- (v) **REFERENCES**
RODDA, P. 1976: Report on the phosphate survey Tuvutha, 175. *Rep. M.R.D. Fiji 1*.
RODDA, P. 1977: Phosphate on Tuvuca - final results of survey. *Note M.R.D. Fiji BP1/16*.
COLLEY, H. 1975: A review of investigations carried out on phosphate deposits in the Lau Group. *M.R.D. Fiji BP9/13*.

- (b) **Preparations:** Survey time is programmed for October 1978.

CCSP-1/FJ.6: Near-shore surveys of coastal areas, beach to reef (Priority A).

- (a) **Proposal:** see TAG-II.
Revision: as follows.
- (i) **BACKGROUND INFORMATION.** To be within general shelf marine surveys by MRD(O) using r.v. *Bulikula*, her tender, and the light-displacement craft *Vanutalei*, for surveys of drying ground, lagoons, beaches, and islets. Such studies are intended to concentrate on a variety of interests, including detrital minerals, coastal engineering, pollution monitoring, the feasibility of wave energy or reef current power extraction, and precious corals.
- (ii) **PROJECT OBJECTIVES.** Mapping of near-shore environments, with special regard to geology, topography, sedimentology, and currents.
- (iii) **ECONOMIC TARGET.** To be kept under review.
- (v) **REFERENCES**
NR/CCOP/SOPAC(6) : CR(FJ)35.
- (b) **Planning:** Mapping of near-shore, drying ground, beaches, and islets to be carried out by MRD.

CCSP-1/FJ.9: Seismic refraction survey, Viti Levu and Vanua Levu (Priority B).

- (a) **Proposal:** TAG-II.
- (i) **BACKGROUND INFORMATION.** Preliminary studies are in hand with reflected phases from earthquakes.
- (ii) **PROJECT OBJECTIVES.** Understanding of the crustal setting of the major sedimentary oceanic basin of Bligh Water between the two main islands of Fiji.
- (iii) **ECONOMIC TARGET.** Delineating the apparently anomalous setting of Bligh Water to determine hydrocarbon and metallogenic potential.
- (iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY.** Basic research.
- (v) **REFERENCES.** Papers summarising and evaluating the many diverse current theories of the geotectonic setting of Fiji are in preparation by Cox, M. & Rodda, P. (MRD, Fiji); Halunen, A.J. (CCOP/SOPAC Tech. Sec., Fiji); Colley, H. & Greenbaum, D. (IGS/UK and MRD, Fiji). These authors should be consulted.

CCSP-1/FJ.11: Marine geological and geophysical investigation of the northern margin of the Fiji Platform (Priority A).

- (a) **Proposal:** see TAG-III.
- (i) **BACKGROUND INFORMATION.** Bathymetric information is at present rudimentary regarding the ocean immediately north of the reef platform margin from Viwa eastward to Kia and Thikobia. Some evidence suggests that sea-floor spreading axial troughs with sulphide brine deposits of future economic interest may be pre-

sent. The area is of great interest as regards the major seismic zone throughout northern Fiji.

(ii) **PROJECT OBJECTIVES.** Bathymetric survey with associated geological sampling and geophysics, allowing recognition of economic targets.

(iii) **ECONOMIC TARGET.** To be assessed.

(iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY.** In line with general Fiji Government interest in oceanic economic development.

(v) **REFERENCES**
NR/CCOP/SOPAC(6)CR.6.

(b) **Planning:** Bathymetric, geological, and geophysical surveys to be carried out by MRD.

✓ **CCSP-1/FJ.12:** Marine geological and geophysical investigations southwards of Suva, between 175°E and 179°W longitude and parallels 18°S and 20°S (Priority A).

(a) **Proposal:** see TAG-III.

Revision: as follows.

(i) **BACKGROUND INFORMATION.** The seas adjacent to Suva will form the study region for the work-up trials of r.v. *Bulikula*, now undergoing acceptance trials by the Government Shipyard, Fiji, for the Mineral Resources Department (Offshore). Basic bathymetric information is required, supplemented by seismic profiling and bottom sampling, to define economic objectives in this area of immediate access from the MRD(O) base.

This project incorporates former projects CCSP-1/FJ.12 (*Marine geological and geophysical investigation of the southern Koro Sea between Viti Levu, Kandavu and Moala Islands* - including description of 1977 cruises) and CCSP-1/FJ.13 (*Marine geological and geophysical surveys south and southwest of Viti Levu* - which includes description of the Suva-Beqa seismic zone and its importance to Fiji's potential earthquake and tsunami hazards).

(ii) **PROJECT OBJECTIVES.** Bathymetric and other studies leading to resource definition and delineation of seismic hazards.

(iii) **ECONOMIC TARGET.** To be assessed.

(iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY.** Basic research.

(v) **REFERENCES**
NC/CCOP/SOPAC(6) : CR.9.
NR/CCOP/SOPAC(6) : CR.31.
NR/CCOP/SOPAC(6) : CR.35.
NR/CCOP/SOPAC(6) : CR.32.B.

(b) **Planning:** Bathymetric and other studies leading to resource definition and delineation of seismic hazards, to be carried out by MRD. This project incorporates former project CCOP-1/FJ.13.

CCSP-1/FJ.13: (Deleted and transferred to CCSP-1/FJ.12).

✓ **CCSP-1/FJ.14:** Interpretation of detailed aeromagnetic data (Priority B).

(a) **Proposal:** see TAG-VI.

(i) **BACKGROUND INFORMATION.** Air- and shipborne magnetic data from relinquished oil company concessions over land and sea cover large areas of Fiji. Data from Bligh Water and the surrounding islands have been re-analysed by Pacific Energy and Minerals Ltd, and by MRD, Fiji. Further re-analysis is required, notably for Lau and off the east coast of Viti Levu.

(ii) **PROJECT OBJECTIVES.** Delineation of sedimentary basins.

(iii) **ECONOMIC TARGET.** Hydrocarbons.

(iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY.** In line with high-priority Government target.

(v) **REFERENCES**
NR/MRS/CCOP/SOPAC(5):CR(FJ)-: Status of Petroleum Exploration in Fiji (1976), by R.N. Richmond, Director of Mineral Development.
NR/MRS/CCOP/SOPAC(6):CR(FJ)-: Oil Company data in Fiji, by F.I. Coulson.

(b) **Planning:** Further re-analysis of existing data from Lau and east coast of Viti Levu required.

CCSP-1/FJ.15: Relocation of selected points throughout the Fiji Group by multiple pass satellite fixes (Priority A).

(a) **Proposal:** see TAG-VI.

Revision: as follows.

(i) **BACKGROUND INFORMATION.** All projects involving the use of satellite navigation require the tabulation of fixed errors and their variation throughout the group, to allow transference of co-ordinates on to present charts. Updating of charts to incoming SATNAV co-ordinates is being undertaken by both the Hydrographic Section, RFN, and the British Admiralty. The fixing of Fiji's offshore boundaries, as Marine Spaces Act April 1978, further requires such data, and an Australian Army Survey is to take satellite fixed co-ordinates throughout the group in 1978-79.

Project CCSP-1/FJ.15 is revised to include former projects CCSP-1/FJ.1A (*Location, Viwa Island, Yasawa Group*) and CCSP-1/FJ.1B (*Location, Great Sea Reef, north of Vanua Levu*).

(ii) **PROJECT OBJECTIVES.** Production of tables of errors between existing charts and SATNAV-determined co-ordinates, to fix routine offshore survey locations.

(iii) **ECONOMIC TARGET.** Delineation of baselines for Fiji's marine spaces.

(iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY.** Base control for assistance to Department of Home Affairs, Fiji.

(v) **REFERENCES**
NR/CCOP/SOPAC(6)CR.31: Report and evaluation of the MX 1102 SATNAV demonstration in Fiji, by R.T.R. Wingfield.
NR/CCOP/SOPAC(7)CR.-: Cruise Report MRD 78-1, by R.T.R. Wingfield.

- (b) *Planning*: Both MRD(O) and CCOP/SOPAC now have 1100 series Magnavox SATNAVs. These will be used to take multi-pass fixes during port visits in Fiji and satfixes on passages/surveys in the group.
- (c) *Preparations*: An Australian army survey party is expected to start primary geodetic surveys in 1978-79.
- (e) *Reports*: NR/CCOP/SOPAC(7):CR.7.

CCSP-1/FJ.16: Geochemical and associated geological investigation of the sea-floor spreading axes of the Fiji Plateau west and north of Fiji (Priority A).

- (a) *Proposal*: see TAG-VI.
 - (i) **BACKGROUND INFORMATION.** Work to date under CCOP/SOPAC initiation on the Fiji Plateau suggests that metalliferous muds or brine pools may be located in association with suspected ridge axial troughs. The deployment of sea-bed seismographs and heat-flow measurements by visiting overseas research vessels would provide useful supplementary data.
 - (ii) **PROJECT OBJECTIVES.** Location and delineation of concentrations of metallic sulphides.
 - (iii) **ECONOMIC TARGET.** Deep-sea metalliferous sediments.
 - (iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY.** Long-term resource assessment.
 - (v) **REFERENCES**

NR/CCOP/SOPAC6-8: Possible occurrence of metalliferous sediments on the Fiji Plateau, by Tech. Sec.

NR/CCIO/SOPAC(6)CR.6: Cruise Report - Fiji Offshore Survey - Yasawa Trough, by A.J. Halunen *et al.*

(Unpublished) Dissertation to Hawaii Institute of Geophysics, by A.J. Halunen.

NR/CCOP/SOPAC(6)CR.24: A preliminary regional geochemical reconnaissance survey for submarine metalliferous sediments in the Southwest Pacific Ocean, by D.S. Cronan and B. Thompson.
- (b) *Planning*: More detailed studies required.

GILBERT ISLANDS

CCSP-1/G.1: Assessment of possibilities for occurrence of offshore phosphate deposits in the Gilbert Islands region (Priority A).

- (a) *Proposal*: see TAG-IV.
 - (i) **BACKGROUND INFORMATION.** Equatorial islands extending from Nauru to the Line Islands, including all those under jurisdiction of the Gilbert Island Government, lie in a region of upwelling and relatively low rainfall, and are most promisingly located for the formation of guano-phosphate and phosphorites. Recoverable submerged guano phosphates may be present on seamounts,

in lagoons, or in unprospected land portions of atolls. Phosphorites may have accumulated on shallow slopes surrounding these islands or on seamounts from upwelled nutrient-rich waters.

- (ii) **PROJECT OBJECTIVES.** To locate and identify areas of sedimentary phosphatic accumulations; to sample and determine extent and thickness of any deposits found; to analyse samples for P_2O_5 content.
- (iii) **ECONOMIC TARGET.** To determine whether economic quantities of sedimentary phosphate mineral exist and can be recovered.
- (v) **REFERENCES**

COOK, P.J. 1975: Prospects for finding offshore phosphates in the Southwest Pacific (Project CCSP-1/REG.11). Pp. 75-85 in *Proceedings of the Third Session CCOP/SOPAC, Apia, Western Samoa, 2-10 September 1974.*

WHITE, W.C.; WARIN, O.N. 1964: A survey of phosphate deposits in the Southwest Pacific and Australian waters. *Bull. Bur. Miner. Resour. Geol. Geophys. Aust.* 69.
- (b) *Planning*: Search for existing technical data to assist locating potential target areas.

CCSP-1/G.2: Investigation of the occurrence of manganese nodules/crusts in the Gilbert Islands region (Priority B).

- (a) *Proposal*: see TAG-IV.
 - (i) **BACKGROUND INFORMATION.** Manganese nodules have been sampled in the deep waters of the region, but their density, distribution, and mineral content are poorly known; crusts are unknown, but may exist. Initial investigations should be done:
 - (1) NE, SE, and SW of the Gilbert Islands chain, and
 - (2) N and S of the Phoenix Island group.
 - (ii) **PROJECT OBJECTIVES.** To establish the existence and distribution of nodules or crusts; to analyse samples for polymetallic content.
 - (iii) **ECONOMIC TARGET.** To assess potential economic deposits.
 - (v) **REFERENCES**

RAWSON, M.D.; RYAN, W.B.F. 1978: Ocean floor sediment and polymetallic nodules. Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York.

TSURUSAKI, K.; HIROTA, T. 1976: Studies on the investigation techniques for deep sea floor mineral resources during the *Hakurei-Mar* cruise GH761 to the Pacific, southwest of Hawaii, 10 January to 9 March 1976. *Saiko to Ho-an (Mining and Safety)* 22: 505-31.

MONGET, J.M.; MURRAY, J.W.; MASCLE, J. 1976: A world-wide compilation of published multicomponent/analyses of ferromanganese concretions. *NSF-IDOE Manganese Nodule Project, Tech. Rep.* 12: 127 pp.
 - (b) *Planning*: Detailed cruise plan based on search of published and unpublished data and bathymetry.

- (c) *Preparations*: Search for existing technical data
- (d) *Field Operations*: To be partially filled by cruise in April 1979 on UNDP charter vessel.

CCSP-1/G.3: Investigation for precious coral in the near-shore waters surrounding the Gilbert Islands (Priority A).

- (a) *Proposal*: see TAG-V.
 - (i) **BACKGROUND INFORMATION**. No known direct evidence exists that precious corals exist in the Gilbert Islands region. However, oceanographic conditions and zoogeographic considerations are very favourable.
 - (ii) **PROJECT OBJECTIVES**. Determine if precious corals exist in the region, and attempt to determine their distribution and density.
 - (iii) **ECONOMIC TARGET**. Assess potential economic occurrences.
 - (v) **REFERENCES**
 GRIGG, R.W. 1977: Hawaii's precious corals. Island Heritage Ltd, Honolulu, Hawaii. 64 pp.
 GRIGG, R.W.; BAYER, F.M. 1976: Present knowledge of the systematics and zoogeography of the order Gorgonacea in Hawaii. *Pacif. Sci.* 30: 167-75.
- (b) *Planning*: Evaluate bathymetry and oceanic current regime to identify where precious coral may exist.
- (c) *Preparations*: Study existing technical data to locate potential target areas.

NEW HEBRIDES

CCSP-1/NH.1: To investigate the metalliferous mud potential in the active volcanic arc and the back arc of the New Hebrides (Priority A).

- (a) *Proposal*: see TAG-VII.
 - (i) **BACKGROUND INFORMATION**. Onshore and near-shore geothermal emanations are known in a number of areas of the New Hebrides. Their situation adjacent to submarine basinal features makes possible a build-up of metal-rich concentrations in the seabed sediments. Samples collected would be analysed by Dr D.S. Cronan of Imperial College, London, as part of a regional geochemical survey of the South Pacific.
 - (ii) **PROJECT OBJECTIVES**. To sample and analyse sediments in submarine basins adjacent to onshore and near-shore geothermal activity.
 - (iii) **ECONOMIC TARGET**. Base metals in marine muds.
 - (iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY**. Extension of the Mineral Survey Project (JDP 200) in the New Hebrides.
 - (v) **REFERENCES**. Regional Reports, Annual Reports, and Occasional Reports of the New He-

brides Geological Survey; ORSTOM transects across the New Hebrides Arc.

- (b) *Planning*: To collect and analyse sediments in submarine basins adjacent to onshore and near-shore geothermal activity, as part of a regional geochemical survey of the South Pacific.
- (c) *Preparations*: Organisation of known available data.

CCSP-1/NH.2: To collate all data relevant to hydrocarbon potential in the New Hebrides, and to recommend (or not) active exploration (priority A).

- (a) *Proposal*: see TAG-VII.
 - (i) **BACKGROUND INFORMATION**. Multi-channel and single-channel reflection and refraction profiles by ORSTOM and various oil companies.
 - (ii) **PROJECT OBJECTIVES**. To synthesise information relevant to hydrocarbon potential in New Hebrides offshore areas.
 - (iii) **ECONOMIC TARGET**. Petroleum.
 - (iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY**. Extension of Mineral Survey Project (JDP 200) in the New Hebrides.
 - (v) **REFERENCES**. Seismic reflection and refraction profiles by ORSTOM and oil companies.
- (b) *Planning*: To collect and synthesise existing ORSTOM and oil company geophysical data, to assess the hydrocarbon potential in the New Hebrides.
- (c) *Preparations*: Organisation of available data.

CCSP-1/NH.3: To determine the potential for precious coral occurrences in New Hebrides offshore areas (Priority A).

- (a) *Proposal*: see TAG-VII.
 - (i) **BACKGROUND INFORMATION**. Nothing is known on the presence or absence of precious corals in New Hebrides offshore areas. The conditions required for their growth, i.e., 200-500 metre depths, 0-3 knot currents, and hard seabottom conditions with minimal sediment supply, are probably present in a number of areas.
 - (ii) **PROJECT OBJECTIVES**. To locate beds of precious coral.
 - (iii) **ECONOMIC TARGET**. Precious corals.
 - (iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY**. Extension of Mineral Survey Project (JDP 200) in the New Hebrides.
 - (v) **REFERENCES**
 GRIGG, R.W. 1971: Status of the precious coral industry in Japan, Taiwan and Okinawa. 1970 *Sea Grant Advisory Rep.* UNIHI-SEAGRANT-AP-71-02: 12 pp.
 GRIGG, R.W. 1976: Fisheries management of precious corals in Hawaii. *Sea Grant Tech. Rep.* UNIHI-SEAGRANT-TR-77-03: 48 pp.
- (b) *Planning*: Identify potential sites from bathymetric data.

- (c) *Preparations*: Existing technical data being reviewed.

CCSP-1/NH.4: Bathymetry mapping of New Hebrides island arc and the adjacent deep sea floor (Priority A).

- (a) *Proposal*: see TAG-VII.

- (i) **BACKGROUND INFORMATION**. Some bathymetric data have been collected by the Royal Navy, IFP, and ORSTOM.
- (ii) **PROJECT OBJECTIVES**. To produce bathymetric maps at 1:500,000 scale.
- (iii) **ECONOMIC TARGET**. To provide topographic maps of the sea floor for the preliminary evaluation of mineral distributions and for extrapolation of on-land geology to adjacent offshore areas.
- (iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY**. Extension of Mineral Survey Project (JDP 200) in the New Hebrides.
- (v) **REFERENCES**. Charts of New Hebrides Marine Department; Royal Navy Reports; IFP and ORSTOM reports.

- (b) *Planning*: Accumulation of data from various repositories.

- (c) *Preparations*: Collection of relevant data to produce 1:500,000 scale bathymetric maps under way.

NEW ZEALAND

CCSP-1/NZ.1: Morphologic, sedimentary, and structural features of the New Zealand shelf and slope (Priority A).

- (a) *Proposal*: see TAG-II.

- (b) *Field Operations*: A number of survey cruises were carried out in 1978.

- (e) *Reports*: See NR/CCOP/SOPAC(7)/CR.2.

CCSP-1/NZ.2: Studies of the southern termination of the Tonga-Kermadec Trench (Priority A).

- (a) *Proposal*: see TAG-II.

- (e) *Reports*: Doyle *et al.* (in press).

CCSP-1/NZ.3: Tectonic history and structure of sedimentary basins offshore from New Zealand (Priority A).

- (a) *Proposal*: see TAG-III.

- (d) *Field operations*: Cruises to southern Lord Howe Rise and Campbell Plateau areas were carried out; work on near-shore basins started by NZGS.

CCSP-1/NZ.4: Study of mafic sands on the western shelf (Priority B).

- (a) *Proposal*: see TAG-VI.

- (b) *Field operations*: Sampling carried out by Waikato University.

CCSP-1/NZ.5: Survey of near-shore detrital sands and gravels (Priority B).

- (a) *Proposal*: See TAG-VI.

- (d) *Field operations*: Surveys were carried out in the New Plymouth, Foveaux Strait, and Wellington Harbour areas by NZOI. A survey of sand build-up erosion on beaches and in the near-shore zone is being completed by Victoria University and the Ministry of Works and Development. Environmental effects of gravel extraction from beaches east of the Wellington Harbour entrance are being studied by NZOI.

- (e) *Reports*: Doctoral theses on gravel deposits and on beach sands are in preparation.

CCSP-1/NZ.6: Investigation of phosphorite and glauconite deposits on the Chatham Rise (Priority A).

- (a) *Proposal*: see TAG-VI.

- (c) *Preparation*: Analysis of samples and studies of the deposits are continuing.

- (e) *Reports*: See NR/CCOP/SOPAC(7)/CR.5.

CCSP-1/NZ.7: Distribution of gold in shelf sediments (Priority B).

- (a) *Proposal*: see TAG-VI.

- (b) *Planning*: Proposed exploratory cruises cancelled.

PAPUA NEW GUINEA

CCSP-1/PN.1: Regional reconnaissance geological mapping, particularly of the outlying islands (Priority B).

- (a) *Proposal*: see TAG-I.

Revision: as follows.

- (i) **BACKGROUND INFORMATION**. Considerable progress has been made towards completing a preliminary mapping of the geology of coastal areas and outlying islands. A few small island groups remain.

- (ii) **PROJECT OBJECTIVES**. Preliminary geological mapping of coastal areas and offshore islands on scales of 1:250,000 and 1:100,000.

- (iii) **ECONOMIC TARGET**. Identification of onshore and near-shore areas where mineral deposits may occur, as a preliminary step towards more detailed investigations.

- (iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY**. A primary function of the Papua New Guinea Department of Minerals and Energy, Geological Survey Division, is to "... promote mineral and petroleum prospecting in onshore and offshore areas".

- (v) **REFERENCES**. Geological Survey of Papua New Guinea — Monthly Report for June 1978.

- (d) *Field operations*: Reconnaissance continuing on unmapped areas; only a few small island groups remain.

- (e) *Reports*: See NR/CCOP/SOPAC(7)/CR.27 and 46.

CCSP-1/PN.2: Preliminary appraisal of detrital heavy minerals in coastal and near-shore areas, and reconnaissance sampling of potentially favourable areas (Priority B).

- (a) *Proposal*: see TAG-I.

Revision: as follows.

- (i) **BACKGROUND INFORMATION.** A preliminary appraisal of mineral sands containing magnetite, titanomagnetite, and chromite was completed in 1974 (see Lowenstein 1974). Gold and/or platinum occurs near the coast in southern "Papua", "New Guinea", New Ireland, New Britain, Bougainville, Woodlark Island, and islands of the Louisiade Archipelago, especially Misima Island. Some beaches have been or are being investigated for detrital minerals, but the potential of other beaches has yet to be assessed.
 - (ii) **PROJECT OBJECTIVES.** To identify prospective beaches and near-shore areas for detrital minerals; to establish the position of former strand lines; to sample and establish the average grade of beach minerals where there is possible economic potential.
 - (iii) **ECONOMIC TARGET.** Assessment of potential of detrital minerals such as magnetite, titanomagnetite, chromite, gold, and platinum.
 - (iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY.** A primary function of the Papua New Guinea Department of Minerals and Energy, Geological Survey Division, is to "... promote mineral and petroleum prospecting in onshore and offshore areas".
 - (v) **REFERENCES**
GRAINGER, D.J.; GRAINGER, R.L. 1974: The mineral deposits map of Papua New Guinea. *Bull. Bur. Miner. Resour. Geol. Geophys. Aust.* 148.
LOWENSTEIN, P.L. 1974: Mineral sands in Papua New Guinea. *Geol. Surv. Papua New Guinea Rep.* 74/29: 5 pp.
- (b) *Planning*: Identification of prospective areas.
- (d) *Field Operations*: Preliminary appraisal of sands containing magnetite, titanomagnetite, and chromite was completed in 1974; other beaches are being investigated now.
- (e) *Reports*: See NR/CCOP/SOPAC(7)/CR.46.

CCSP-1/PN.3: Crustal study of eastern Papua New Guinea (Priority A).

- (a) *Proposal*: see TAG-I.

Revision: as follows.

- (i) **BACKGROUND INFORMATION.** Interpretation and modelling studies have been conducted on data from the 1973 East Papua Crustal Survey undertaken by the Australian Bureau of Mineral Resources (BMR). There are also interpretations of recently compiled gravity data obtained from

many different sources, and high-level aeromagnetic data from surveys conducted by the BMR (see References).

- (ii) **PROJECT OBJECTIVES.** To study the basic structure in the sea area between New Britain and eastern Papua New Guinea, particularly the Trobriand Platform (gravity) and northern Solomon Sea.

- (v) **REFERENCES**

FINLAYSON, D.M.; DRUMMOND, G.J.; COLLINS, C.D.M.; CONNELLY, J. 1976: Crustal structure in the region of the Papuan Ultramafic Belt. *Phys. Earth Planet. Inter.* 14 (1977): 13-29.

- (b) *Planning*: Geological Survey to co-ordinate surveys and input from other organisations, with emphasis on the Trobriand Platform and north Solomon Sea areas.
- (d) *Field Operations*: Gravity survey of Waw-Markham areas completed, and existing data are being interpreted.
- (f) *Publications*: Findlayson, D.M. et al., *Phys. Earth Planet. Inter.* 14 (1977): 13-29.

CCSP-1/PN.4: Inshore and near-shore surveys related to harbour development and coastal management (Priority A).

- (a) *Proposal*: see TAG-IV.

Revision: as follows.

- (i) **BACKGROUND INFORMATION.** The Geological Survey of Papua New Guinea has been requested to perform preliminary site investigations for several proposed wharves and potential harbour developments associated with on-going and near-future natural resource development projects. Such investigations, which involve bathymetric surveys, bottom sampling and possibly coring, and seismic surveys, are currently beyond the scope of the GSPNG.
 - (ii) **PROJECT OBJECTIVES.** To assist in the location and foundation design of proposed wharves and associated structures by providing data on bathymetry and on sediment type and thickness.
 - (iii) **ECONOMIC TARGET.** To assist in the design and construction of coastal transportation facilities for ongoing and near-future natural resource development projects.
 - (iv) **RELATIONSHIP OF PROJECT TO DEVELOPMENT POLICY.** The development of natural resources (minerals, fisheries, forests, etc.) and associated transportation systems, taking into account environmental impacts, is a key point of the National Development Strategy of the nation.
- (b) *Planning*: Identification of potential harbour sites and areas where development is planned; preparation of base maps.

CCSP-1/PN.5: An evaluation of the hydrocarbon potential of offshore areas in Papua New Guinea from existing data (Priority A).

- (a) *Proposal*: TAG-VII (new project).

- (i) **BACKGROUND INFORMATION.** A considerable quantity of geophysical data and some drillhole data from offshore areas is held on open file at the PNG Geological Survey, Port Moresby. To renew interest in the hydrocarbon potential of offshore areas, these data need to be catalogued, reviewed, and re-interpreted.
- (ii) **PROJECT OBJECTIVES.** To evaluate the existing offshore basins, and prepare a report on the potential of each; to identify areas for which more data are needed, and to formulate a programme for collecting such data.
- (iii) **ECONOMIC TARGET.** Assessment of potential for hydrocarbons in offshore areas.
- (iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY.** A primary function of the Papua New Guinea Department of Minerals and Energy, Geological Survey Division, is to "... promote mineral and petroleum prospecting in onshore and offshore areas".
- (v) **REFERENCES**

BICKEL, R.S. 1976: Cape Vogel Basin. Pp. 506-13 in R.B. LESLIE, H.J. EVANS, & C.L. KNIGHT (Eds), "Economic Geology of Australia and Papua New Guinea. 3. Petroleum". The Australian Institute of Mining and Metallurgy. *Monograph Series No. 7*.

BROIN, C.E. de; AUBERTIN, F.; RAVENNE, C. 1977: Structure and history of the Solomon - New Ireland Region. Pp. 37-50 in Papers presented at the International Symposium on the Geodynamics in South-west Pacific, Noumea (New Caledonia), 27 August - 2 September 1976. Editions Technip, Paris.

TJHIN, K.T. 1976: Trobriand Basin Exploration, Papua New Guinea. *The APEA JI 1976*: 81-90. See also unpublished open file reports in GSPNG archives.

- (b) *Planning*: Collating and re-interpretation of existing oil company data on open file at the Geological Survey, to identify potential target areas for hydrocarbons.

CCSP-1/PN.6.: An investigation into the hydrocarbon potential of offshore areas of the Cape Vogel Basin (Priority A).

- (a) *Proposal*: TAG-VII (new project).

- (i) **BACKGROUND INFORMATION.** The Cape Vogel Basin extends for 450 km along the north-east side of eastern Papua New Guinea. Its name is derived from the Cape Vogel Peninsula, where the only significant sequence of sedimentary rock in the basin is exposed. The approximately 41,000 km² basinal area is 90% overlain by water, with most of the remaining 10% covered by alluvium and recent volcanic deposits. On bathymetric charts the area appears as a large, triangular, dominantly shallow-water shelf.

Aeromagnetic data have recently outlined three sub-basinal areas that roughly parallel the Owen Stanley Ridge - the mountainous core (backbone) of eastern New Guinea - and a separate, fourth

basinal area between the D'Entrecasteaux and Trobriand Islands. From north-west to south-east the Sub-basins are the Buna, Tufti, and Goodenough Bay. The fourth area is referred to as the Trobriand Basin. Aeromagnetic basement depth estimates are over 3,000 m in the Buna Sub-basin, but shallow to only 1,525 m in the Goodenough Bay Sub-basin, of which 1,000 m is water.

On Cape Vogel Peninsula, 4,000 m of Miocene and Pliocene clastic sediments overlie limestone, which overlaps Lower Miocene siltstones and rests unconformably on volcanics of Late Oligocene age. In the north-western part of the area, at Robinson Bay, the same limestone is underlain by sediments also of Late Oligocene age.

Present indications are that the basins contain enough sediments of varying lithologies to have generated hydrocarbons and provided reservoirs for entrapment. Although folding is present, no complex structures are indicated. Any hydrocarbon formed within the basin is probably still present.

- (ii) **PROJECT OBJECTIVES.** (Aims and limits to be defined following a review of existing data - see project CCSP-1/PN.5.)

- (v) **REFERENCES**

BICKEL, R.S. 1976: Cape Vogel Basin. Pp. 506-13 in R.B. LESLIE, H.J. EVANS, & C.L. KNIGHT (Eds), "Economic Geology of Australia and Papua New Guinea. 3. Petroleum". The Australian Institute of Mining and Metallurgy. *Monograph Series No. 7*.

TJHIN, K.T. 1976: Trobriand Basin Exploration, Papua New Guinea. *The APEA JI 1976*: 81-90.

See also open file report in GSPNG archives.

- (b) *Planning*: Objectives and limits to be defined following review of existing data.
- (c) *Reports*: See NR/CCOP/SOPAC(7)/CR.46.

CCSP-1/PN.7: An investigation into the hydrocarbon potential of the New Ireland Basin (Priority A).

- (a) *Proposal*: TAG-VII (new project).

- (i) **BACKGROUND INFORMATION.** The New Ireland Basin lies immediately north of Manus Island and New Ireland, and extends south-eastward off eastern New Ireland and south of Bougainville. Sediments are up to 4 km thick in smaller basins along the main basin axis. One hole (L'Etoile) was drilled in 1975 off Bougainville. Drilling for a mid Miocene reef, the hole bottomed in Miocene volcanoclastics at 1681 m and was dry.
- (ii) **PROJECT OBJECTIVES.** (Aims and limits to be defined following a review of existing data - see project CCSP-1/PN.5.)

- (v) **REFERENCES**

BROIN, C.E. de; AUBERTIN, F.; RAVENNE, C. 1977: Structure and history of the Solomon - New Ireland Region. Pp. 37-50 in Papers presented at the International Symposium on the Geodynamics in South-west Pacific, Noumea (New Caledonia),

27 August - 2 September 1976. Editions Technip, Paris.

See also open file reports in GSPNG archives.

- (b) *Planning*: Objectives and limits to be defined following review of existing data.
- (c) *Preparations*: First cruises by UNDP charter vessel to be carried out in March 1979.
- (e) *Reports*: See NR/CCOP/SOPAC(7)CR.46.

CCSP-1/PN.8: To explore for and evaluate the potential of possible metalliferous sediments in basins where there is known high heat flow or nearby volcanic activity (Priority B).

- (a) *Proposal*: TAG-VII (new project).

- (i) **BACKGROUND INFORMATION.** Metalliferous sediments of submarine hydrothermal origin have occasionally been reported in island arc complexes and their associated marginal seas. The greatest potential for ore-grade enrichment is in enclosed basins with ponded sediments where heat flow values are high, or in areas where there is volcanic activity.

Some heat flow values are high in the Woodlark and Solomon Sea Basins, and probably also in parts of the Manus and New Guinea Basins. Volcanic activity borders all these basins. The potential for metalliferous sediments in these areas is not known, since very few sediment samples have been analysed.

- (iii) **ECONOMIC TARGET.** Potential assessment of metalliferous sediments in offshore areas.
 - (iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY.** A primary function of the Papua New Guinea Department of Minerals and Energy, Geological Survey Division, is to "... promote mineral and petroleum prospecting in onshore and offshore areas".
 - (v) **REFERENCES**

CRONAN, D.S. 1978: Regional geochemical reconnaissance survey for submarine metalliferous sediments in the Southwestern Pacific Ocean - a preliminary note. *Trans. Inst. Min. Metall. (Sect. B)* 87: B87-9.

MILSON, J.S. 1970: Woodlark Basin, a minor center of sea-floor spreading in Melanesia. *J. geophys. Res.* 75(35): 7335-9.

HALUNEN, A.J.; HERSEN, R.P. von 1973: Heat flow in the western equatorial Pacific Ocean. *J. geophys. Res.* 78(23): 5195-208.

- (b) *Planning*: Review bathymetric data and, if necessary, prepare bathymetric maps of areas to be sampled to identify primary target areas (i.e., small sediment-filled basins in high heat flow regions).
 - (c) *Preparations*: First cruises by UNDP charter vessel to be carried out in March 1979.
 - (e) *Reports*: See NR/CCOP/SOPAC(7)/CR. 46.

CCSP-1/PN.9: An evaluation of the potential for submarine phosphate deposits in northern Papua New Guinea (Priority B).

- (a) *Proposal*: TAG-VII (new project).

- (i) **BACKGROUND INFORMATION.** Conditions have been favourable in the past, and are still favourable, for phosphate formation as both guano deposits and phosphorite in northern waters of Papua New Guinea. Guano deposits may occur on submerged seamounts at depths sufficient to prevent reef growth (> 50 m) yet not so great as to make recovery prohibitively expensive (taken arbitrarily as a maximum of 1000 m water depth). Phosphorite may occur on shallow, current-swept ridges in the Ninigo Group, Admiralty Islands, St Mathias Group, and other island groups north of New Ireland and Bougainville.

- (ii) **PROJECT OBJECTIVES.** To identify areas where phosphatic sediments may have accumulated; to sample those areas and determine the areal extent of any deposits found; to determine by analysis the grade of any deposits found.

- (iii) **ECONOMIC TARGET.** Assessment of the potential of offshore phosphatic deposits.

- (iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY.** A primary function of the Papua New Guinea Department of Minerals and Energy, Geological Survey Division, is to "... promote mineral and petroleum prospecting in onshore and offshore areas".

- (v) **REFERENCES**

COOK, P.J. 1975: 11. Prospects for finding offshore phosphate deposits in the South-west Pacific (Project CCSP-1/SOPAC, Apia, Western Samoa, 2-10 September 1974).

- (b) *Planning*: From a review of bathymetric data potential sites need to be identified, especially guyots whose tops lie 50-1000 m from the sea surface.
 - (c) *Preparations*: First cruises to be carried out by UNDP charter vessel in March 1979.

CCSP-1/PN.10: An evaluation of manganese nodule deposits north of the West Melanesian Trench (Priority B).

- (a) *Proposal*: TAG-VII (new project).

- (i) **BACKGROUND INFORMATION.** Manganese nodules and crusts occur on the north side of the West Melanesian Trench north of the Admiralty Islands, New Ireland, and Bougainville. Sampling density is very poor in this region, and the density and areal extent of these deposits are not known. The "field" is high in cobalt and nickel and low in copper.

- (ii) **PROJECT OBJECTIVES.** To establish the distribution of manganese nodules and crusts north of the West Melanesian Trench in Papua New Guinea territorial waters; to establish their metal content and density, so that their potential may be evaluated.

(iii) **ECONOMIC TARGET.** Assessment of the potential of manganese nodules and crusts, especially their metal contents (i.e., Cu, Ni, Co).

(iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY.** A primary function of the Papua New Guinea Department of Minerals and Energy, Geological Survey Division, is to "... promote mineral and petroleum prospecting in onshore and offshore areas".

(v) **REFERENCES**

ANDREWS, J.E.; LANDMESSER, C.W. 1973: HIG manganese samples: Physical property descriptions. Pp.1-133 in J.E. ANDREWS *et al.*, "HIG data banks for manganese collections and hydration-rind dating".

RAWSON, M.D.; RYAN, W.B.F. 1978: Ocean floor sediment and polymetallic nodules. *Lamont-Doherty Geol. Obs. World Map*, 1:23,230,000, Sheet 1.

CCSP-1/PN.11: Bathymetric mapping of the sea floor of Papua New Guinea (Priority A).

(a) *Proposal:* TAG-VII (new project).

(i) **BACKGROUND INFORMATION.** Improved bathymetric charts are required to assist in the initial phases of several offshore mineral projects. Considerable data exists that is suitable for the production of 1:1,000,000 scale charts, and as mineral surveys are carried out additional data will be collected, allowing the construction of more detailed, larger-scale maps. These more detailed maps will be needed to assist in the economic evaluation of potential mineral prospects.

(ii) **PROJECT OBJECTIVES.** To collate depth data for PNG offshore areas, prepare depth collectors, and draw bathymetric maps on a scale of 1:1,000,000; to prepare bathymetric maps on a scale of 1:250,000 for specific areas where the mineral potential demonstrates the need for more detailed mapping.

(iii) **ECONOMIC TARGET.** The production of bathymetric maps needed for mineral prospecting and mining activities in offshore areas.

(iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY.** A primary function of the Papua New Guinea Department of Minerals and Energy, Geological Survey Division, is to "... promote mineral and petroleum prospecting in onshore and offshore areas".

(b) *Planning:* Collection of data.

CCSP-1/PN.12: An assessment of the potential of deep-water precious corals (especially *Corallium*) in Papua New Guinea (Priority B).

(a) *Proposal:* TAG-VII (new project).

(i) **BACKGROUND INFORMATION.** *Corallium* species occur at depths between 100 m and 500 m throughout the western Pacific and Hawaii. Harvesting is carried out commercially throughout this region, and coral jewellery industries are well es-

ablished, especially in Japan, Taiwan, and Hawaii. *Corallium* has also been found in the Halmahera Islands and Solomon Islands, and prospects of finding it in Papua New Guinea are good.

(ii) **PROJECT OBJECTIVES.** To establish the distribution and abundance of deep-water precious corals in Papua New Guinea; to establish their quality, and evaluate their potential as a resource.

(iii) **ECONOMIC TARGET.** To determine whether sufficient deep-water precious corals exist in Papua New Guinea to supply a coral jewellery industry.

(v) **REFERENCES**

GRIGG, R.W. 1976: Fisheries management of precious corals in Hawaii. *SEAGRANT Tech. Rep. UNIHI-SEAGRANT-TR-77-03*: 48 pp.

GRIGG, R.W. 1971: Status of the precious coral industry in Japan, Taiwan and Okinawa. *1970 Sea Grant Advisory Rep. UNIHI-SEAGRANT-AR-71-02*: 12 pp.

(b) *Planning:* Collating and review of existing data to locate favourable areas for investigations to be undertaken.

SAMOA

CCSP-1/WS.1: Assessment of possibilities of seabed phosphorites on the slopes of the Samoa Platform and seamounts north-west of Savai'i and south of Upolu (Priority B).

(a) *Proposal:* TAG-I.

Revision: as follows.

(i) **BACKGROUND INFORMATION.** Seabed phosphorites occur in relatively shallow areas of the sea where upwelling of nutrient-rich deep ocean water is prevalent. Such water often supports prolific life. Typical areas where seabed phosphorites are found are the Chatham Rise, south-east of New Zealand, and off the coast of Peru. The precise mode of formation of seabed phosphorites is not clearly understood. No area is known where seabed phosphorites are being mined economically; rather, these resources are being considered as a possible substitute for phosphate when other reserves in the region are depleted. Preliminary surveys were reported in NR/CCOP/SOPAC(6)/CR.7.

(ii) **PROJECT OBJECTIVES.** To collect dredge samples from seamounts north-west and south of Samoa of appropriate economic depth, and from banks and ridges surrounding the main islands.

(iii) **ECONOMIC TARGET.** Phosphorite.

(v) **REFERENCES**

COOK, P.J. 1975: Prospects for finding offshore phosphate deposits in the South-west Pacific. Pp. 75-85 in ANON, Proceedings of the Third Session of CCOP/SOPAC, Apia, Western Samoa, September, 1974.

(b) *Planning:* Identification of potential sites from bathymetric data.

CCSP-1/WS.2: Seabed investigations for manganese deposits on the Samoa Platform and in Samoan oceanic areas (Priority A).

(a) *Proposal:* TAG-I.

Revision: as follows.

(i) **BACKGROUND INFORMATION.** Manganese deposits are found on shallow ridges or plateaus generally as encrustations, and in the deep ocean generally as nodules. These deposits have economic interest mainly as a result of the copper, nickel, cobalt, and other metals found in association with the manganese. The mode of formation of the deposits is not clear, and many hypotheses have been proposed to explain their occurrence. The search for manganese nodules in the deep sea is being actively pursued by several large consortia, as well as the technology for their recovery and processing.

(ii) **PROJECT OBJECTIVES.** To collect samples from the deep sea using appropriate samplers (either free-fall or wire-lowered); using rock dredges, to collect samples from seamounts in the region.

(iii) **ECONOMIC TARGET.** Copper, nickel, and other metals found associated with the manganese nodules and crusts.

(v) **REFERENCES**

LONSDALE, P. 1975: Sedimentation and Tectonic Modification of Samoan Archipelagic Apron. *Am. Assoc. Pet. Geol. Bull.* 59: 780-98.

MEYLAN, M.A.; BACKER, H.; GLASBY, G.P. 1975: Manganese nodule investigations in the Southwestern Pacific Basin, 1974. *NZOI oceanogr. Fld Rep.* 4: 24 pp.

KEAR, D.; WOOD, B.L. 1959: The Geology and Hydrology of Western Samoa. *NZ DSIR Bull.* 63: 92 pp.

(b) *Planning:* Compile bathymetric information for the region, incorporating satellite-controlled data to correct bathymetric data collected earlier without satellite-controlled navigation.

CCSP-1/WS.4: Investigation of the deeper flanks of the island slope for precious coral (Priority A).

(a) *Proposal:* TAG-V.

(i) **BACKGROUND INFORMATION.** Precious coral is the hard, solid skeleton of several species of coral which grown on hard bottom (usually limestone) in water depths of about 150 to 500 metres where bottom currents range from 0 to 3 knots. This material is used to make jewellery. The industry in Hawaii grosses \$20 million annually; throughout the Pacific a \$400 million industry exists. Likely areas for precious coral in Samoa are north-west of Savai'i, south-east of Upolu, and some banks and seamounts rising from the deep ocean which provide the appropriate environment.

These areas should be investigated initially using "stones" and tangle nets, followed where

warranted by use (possibly) of a deep submersible to delineate the quantities and species of coral found. In some areas bathymetric surveys will be necessary to delineate ocean depth and bottom type before sample collection.

(ii) **PROJECT OBJECTIVES.** To survey and collect samples to evaluate the potential of precious coral resources.

(iii) **ECONOMIC TARGET.** Precious coral.

(v) **REFERENCES**

GRIGG, R.W. 1971: Status of the precious coral industry in Japan, Taiwan and Okinawa. *1970 Sea Grant Advisory Report UNIH-SEAGRANT-TR-77-03:* 48 pp.

(b) *Planning:* Working up of existing bathymetric data.

(c) *Preparations:* Survey time is programmed for December 1978.

(d) *Field Operations:* NW Savai'i precious coral survey (WS.78-1).

CCSP-1/WS.5: Coastal zone management surveys for landfill, construction materials, and harbour construction (Priority A).

(a) *Proposal:* TAG-VI.

Revision: as follows.

(i) **BACKGROUND INFORMATION.** The mining of coral and sand for landfill and construction purposes nearly always upsets the natural regime of the shoreline environment. A careful study of this environment will provide an understanding of the effects of these changes, and minimize the problems in the area.

A survey of the site where large quantities of coral were dredged off Mulinu'u Point, to determine sediment thickness, if possible, and the extent of the excavation. A survey of the inner part of Apia Harbour to determine sediment thickness preliminary to drilling for engineering studies of the bottom, necessary for construction of a roll on — roll off docking facility. Other harbours may require surveying in the future.

(ii) **PROJECT OBJECTIVES.** To provide baseline data to aid in selection of sites for mining construction materials and constructing harbour facilities.

(iii) **ECONOMIC TARGET.** Not applicable.

(d) *Field operations:* Apia Harbour survey (WS.78-1).

(e) *Reports:* NR/CCOP/SOPAC(7)/CR.25.

CCSP-1/WS.6: Crustal seismic survey of sediment thickness and basement structure of the Samoan platform, to determine the hydrocarbon potential (Priority B).

(a) *Proposal:* TAG-VII (new project).

(i) **BACKGROUND INFORMATION.** A seismic reflection survey of the shallow areas along the north side of Upolu and in Apolima Strait. The

likelihood of hydrocarbons existing in Samoa is small, yet no area should be written off without some investigation.

(ii) **PROJECT OBJECTIVES.** To determine the structural relationships in Apolima Strait and along the north coast of Upolu.

(iii) **ECONOMIC TARGET.** Hydrocarbons.

(v) **REFERENCES**

KEAR, D.; WOOD, B.L. 1959: The geology and hydrology of Western Samoa. *Bull. N.Z. Dep. scient. ind. Res.* 63: 92 pp.

LONSDALE, P. 1975: Sedimentation and tectonic modification of Samoan Archipelagic apron. *Bull. Am. Assoc. petrol. Geol.* 59: 780-98.

(b) *Planning:* Need to check research institutions to see if reflection profilers have been operated during passage through Apolima Strait.

SOLOMON ISLANDS

CCSP-1/SI.1: Coastal survey, Choiseul to Santa Isabel Islands (Priority B).

(a) *Proposal:* TAG-I.

Revision: as follows.

(i) **BACKGROUND INFORMATION.** Raw data are available on bathymetry, gravity, and magnetics from a survey carried out by HMS *Hydra* from May 1972 to September 1973 in Bougainville Strait, New Georgia Sound, Manning Strait, the Slot, and waters adjacent to Choiseul and northern Santa Isabel Islands. There are data from other sources (e.g., ORSTOM) also.

(ii) **PROJECT OBJECTIVES.** To interpret the bathymetry, magnetics, and gravity of the offshore region in the western Solomon Islands, and relate the results to the results of on-land mapping and regional geology.

(iii) **ECONOMIC TARGET.** To use the results of this interpretation to evaluate the offshore mineral potential of the western Solomon Islands.

(v) **REFERENCES.** Solomon Islands Work Programme, p. 26. Annex IV in Proceedings of the Fourth Session, CCOP/SOPAC, ESCAP.

CCSP-1/SI.2: Transverse seismic profiling of the Solomon Basin (the 'Slot' area) (Priority A).

(a) *Proposal:* TAG-I.

Revision: as follows.

(i) **BACKGROUND INFORMATION.** A sedimentary basin extends 1600 km from northern Papua New Guinea to the central Solomon Islands. In the south-east this is called the Solomon Basin, and corresponds to the 'Slot' bathymetric depression. It is approximately 70 km wide, and extends from the Shortland Islands to Guadalcanal. Maximum sediment thicknesses are between 4000 m and 5000 m. Some seismic reflection data exist, but most lines lie parallel to the axis of the basin, and few cross it.

(ii) **PROJECT OBJECTIVES.** To collect seismic reflection data in the 'Slot', especially NE-SW traverses, to supplement data already collected; based on this data, to evaluate the hydrocarbon potential of the Solomon Basin.

(iii) **ECONOMIC TARGET.** Establishment of the hydrocarbon potential of the Solomon Basin.

(v) **REFERENCES**

BROIN, C.E. de; AUBERTIN, F.; RAVENNE, C. 1977: Structure and history of the Solomon - New Ireland Region. Pp. 37-50 in Papers presented at the International Symposium on the Geodynamics in South-west Pacific, Noumea (New Caledonia), 27 August - 2 September 1976. Editions Technip, Paris.

(b) *Planning:* Review existing seismic reflection data and prepare a survey programme (see Project CCSP-1/SI.10).

(d) *Field Operations:* To be partly filled by survey by UNDP charter vessel in early 1979.

CCSP-1/SI.3 (Deleted and transferred to CCSP-1/REG.1).

CCSP-1/SI.4: Investigation of shallow submerged plateaus in Manning Strait and south-west of Choiseul Island for bauxite deposits (Priority B).

(a) *Proposal:* see TAG-III.

Revision: as follows.

(i) **BACKGROUND INFORMATION.** A study of bauxite deposits in Lake Te Nggano on Rennell Island has concluded that these deposits have been formed by sub-aerial weathering of limestone (and possibly also volcanic ash) and subsequent flooding by tectonic subsidence or eustatic sea level change (Eade & Iko, in prep.). This is contrary to the view of Taylor & Hughes (1975), who conclude that the Lake Te Nggano bauxite originated by the biogenic destruction of volcanic dust or ash falls in an active lagoonal environment. A preliminary search for bauxite deposits off Vaghena Island failed to penetrate more than 0.8 m, recovering only unconsolidated calcareous sands. However, in the submerged areas in the vicinity of Vaghena there may be bauxite deposits beneath the calcareous overburden. Deeper sampling remains to be carried out in areas of subsidence, to establish whether bauxite lies beneath the calcareous sands and to find the thickness of the overburden.

(ii) **PROJECT OBJECTIVES.** To establish the distribution of bauxite on plateaus in Manning Strait and south-west of Choiseul Island; to estimate the quantity and quality of these deposits, and establish the thickness of overburden present.

(iii) **ECONOMIC TARGET.** To assess the bauxite potential of shallow submerged plateaus.

(v) **REFERENCES**

ANON. 1976: Report of the CCOP/SOPAC-IOC IDOE International Workshop. Pp. 31-55 in Proceedings of the Fourth Session of CCOP/SOPAC, Honiara, Solomon Islands, September 1975.

EADE, J.V.; IKO, S. (in prep.): Lake Te Nggano Bauxite: A drowned deposit. *S. Pacif. mar. geol. Notes*.

TAYLOR, G.R. 1977: Investigation of shallow submerged plateaus in the Manning Straits and southwest of Choiseul Island. results of the February 1976 Expedition. *S. Pacif. mar. geol. Notes* 1(4): 41-6.

TAYLOR, G.R.; HUGHES, G.W. 1975: Biogenesis of Rennell Bauxite. *Econ. Geol.* 70: 542-6.

- (b) *Planning*: Construct detailed bathymetric maps from existing data, especially data collected by HMS *Hydra* (see CCSP-1/SI.1). Identify areas of subsidence from existing geological data, especially where coral reef growth is minimal and the supply of carbonate sand is low.

CCSP-1/SI.5: Investigation of detrital gold in beach and nearshore areas off central north Guadalcanal (Priority B).

- (a) *Proposal*: see TAG-IV.

Revision: as follows.

- (i) BACKGROUND INFORMATION. A review has been made of the on-land occurrence of gold associated with the Gold Ridge deposit, and a detailed survey of the near-shore area off central north Guadalcanal has been completed. These studies conclude that fine-grain gold has been transported to the coast and adjacent near-shore area, and that buried layers exist where gold may be concentrated. However, the coring equipment used was not able to penetrate to these buried layers. Follow-up work should include a review of recovery techniques for fine-grain gold, followed by a beach survey and offshore drilling and coring.
- (ii) PROJECT OBJECTIVES. To define the distribution and quantity of fine-grain detrital gold in beach and near-shore areas recognised as favourable for gold concentration in Tetere Bay and west of Koli Point.
- (iii) ECONOMIC TARGET. To establish the potential of fine-grain gold.
- (v) REFERENCES

TURNER, C.C.; EADE, J.V.; DANITOFEA, S.; OLDNALL, R. 1977: Gold-bearing sediments on the continental shelf of northern Guadalcanal, Solomon Islands. *S. Pacif. mar. geol. Notes* 1(6): 55-70.

- (b) *Planning*: Recovery techniques for fine-grain gold to be reviewed.

CCSP-1/SI.6: Investigation of the phosphate potential of submerged seamounts and current-swept ridges (Priority B).

- (a) *Proposal*: see TAG-IV.

Revision: as follows.

- (i) BACKGROUND INFORMATION. A small deposit (5,000 tonnes) of guano phosphate occurs

on Bellona Island. Similar deposits may occur on submerged seamounts in the region. Cook (1975) identifies an area north of the Solomon Islands where guano phosphate may occur. Another possibility is the seamount at approximately 10°30'S, 159°45'E.

- (ii) PROJECT OBJECTIVES. To discover submerged phosphate deposits; to establish the size and grade of each discovery.
- (iii) ECONOMIC TARGET. Evaluate the potential of submarine phosphate deposits.
- (v) REFERENCES

COOK, P.J. 1975: Prospects for finding offshore phosphate deposits in the southwest Pacific. Pp. 75-85 in ANON., Proceedings of the Third Session of CCOP/SOPAC, Apia, Western Samoa, September 1974.

- (b) *Planning*: Identification from bathymetry of selected seamounts and current-swept ridges where phosphate may occur.

CCSP-1/SI.7: Investigation into the discharges from submarine volcanoes in the Solomon Islands (Priority B).

- (a) *Proposal*: see TAG-IV.

Revision: as follows.

- (i) BACKGROUND INFORMATION. Mineral deposits have been found associated with submarine volcanism in Indonesia (Zelenov 1964). Submarine volcanoes in the Solomon Islands may also be sites of mineral precipitation and accumulation.
- (ii) PROJECT OBJECTIVES. To sample rocks and sediments to determine whether or not mineral deposits are accumulating on or near active submarine volcanoes in the Solomon Islands; to determine mineral grades of such deposits.
- (iii) ECONOMIC TARGET. To evaluate the potential of mineral deposits associated with submarine volcanism.
- (v) REFERENCES

ZELENOV, K.K. 1964: Iron and manganese in exhalations of the submarine Banu Wahu Volcano (Indonesia). *Dokl. Akad. Nauk. USSR* 155: 1317-20.

CRONAN, D.S. 1978: Regional geochemical reconnaissance survey for submarine metalliferous sediments in the southwestern Pacific Ocean — a preliminary note. *Trans. Inst. Min. Metall.* 87: B87-9.

- (b) *Planning*: Prepare bathymetric maps of areas to be surveyed.

- (e) *Reports*: Cronan, D.S. 1978: *Trans. Inst. Min. Metall.* 87: 87-9.

CCSP-1/SI.8: Investigations into metal dispersion in marine sediments around Vella Lavella and in other nearby areas (Priority B).

- (a) *Proposal*: see TAG-IV.

Revision: as follows.

- (i) **BACKGROUND INFORMATION.** Where ponded sediments occur in enclosed basins in regions of high heat flow, metalliferous enrichment of the sediments is likely to occur. The classic model is in the Red Sea. The most likely area in the Solomon Islands for metal-enriched sediments is the New Georgia group, especially Vella Gulf, Kula Gulf, and Blanche Channel.
- (ii) **PROJECT OBJECTIVES.** To find basins where sediments contain mineral concentrations from hydrothermal solutions; to establish the quantity and grade of these deposits.
- (iii) **ECONOMIC TARGET.** To evaluate the potential of metalliferous sediments in the New Georgia group (primary minerals include Cu and Zn).
- (v) **REFERENCES**
CRONAN, D.S. 1978: Regional geochemical reconnaissance survey for submarine metalliferous sediments in the southwestern Pacific Ocean - a preliminary note. *Trans. Inst. Min. Metall.* 87: B87-9.
- (b) *Planning:* Prepare a bathymetric map of the New Georgia group to identify specific target areas.
- (d) *Field Operations:* To be partly filled by survey by the UNDP charter vessel in early 1979.

CCSP-1/SI.9: Search for bauxite sediments inside Indispensable Reefs and in Lake Te Nggano, Rennell Island (Priority A).

- (a) *Proposal:* see TAG-V.

Revision: as follows.

- (i) **BACKGROUND INFORMATION.** Discovery of bauxite in Lake Te Nggano has led to the theory that bauxite may have been produced by biogenic activity in a shallow-water environment. At the time this project was proposed, Indispensable Reefs offered a likely place to test this theory. Lake Te Nggano sediment had been sampled in only a few localities, and then only in shallow water. Surveys of both Indispensable Reefs and Lake Te Nggano were carried out jointly by Geology Division, Honiara, and CCOP/SOPAC Technical Secretariat, Suva. First analyses of samples indicate that the bauxite present is low in iron. Further analyses are needed.
- (ii) **PROJECT OBJECTIVES.** To search for bauxite in Indispensable Reefs and Lake Te Nggano, and establish quantity and quality of deposits found; to test the lagoon origin theory of bauxite, and therefore discover whether lagoons are potential target areas for finding bauxite deposits.
- (iii) **ECONOMIC TARGET.** To establish the quantity and quality of bauxite present and especially whether the bauxite is low in iron.
- (v) **REFERENCES**
TAYLOR, G.R.; HUGHES, G.W. 1975: Biogenesis of the Rennell Bauxite. *Econ. Geol.* 70: 542-6.

CCSP-1/SI.10: Evaluation of hydrocarbon potential in Solomon Islands offshore areas (Priority A).

- (a) *Proposal:* TAG-VII (new project).

- (i) **BACKGROUND INFORMATION.** A considerable volume of data resulting from marine geophysical reconnaissance in Solomon Islands waters is held in the Geology Division Office, Ministry of Natural Resources, Honiara. Many private prospecting companies, overseas universities, and research centres have made their data available.
- (ii) **PROJECT OBJECTIVES.** To examine available marine geophysical data and recommend a suitable system for classification and filing; to recommend, from examination of seismic reflection data and bathymetry, priority areas for further marine exploration, with particular reference to petroleum prospects.
- (iii) **ECONOMIC TARGET.** To stimulate a serious search for hydrocarbons in the Solomon Islands.
- (iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY.** This project is directly related to planning an exploration programme to investigate the resources of Solomon Islands seas.
- (d) *Field Operations:* Partly completed by evaluations carried out by UNDP consultant petroleum geologists in late 1978.

CCSP-1/SI.11: Bathymetry and geophysical profiling and bottom sampling in Manning Strait (Priority A).

- (a) *Proposal:* TAG-VII (new project).

- (i) **BACKGROUND INFORMATION.** A preliminary study of one seismic reflection track through Manning Strait shows promising potential for hydrocarbon occurrence in this area. Further data are needed from Manning Strait to follow up this work before a full assessment can be made of hydrocarbon potential.
- (ii) **PROJECT OBJECTIVES.** To evaluate hydrocarbon potential in Manning Strait and adjacent areas.
- (iii) **ECONOMIC TARGET.** To show to petroleum companies the hydrocarbon potential of this area and, if favourable, to stimulate detailed exploration.
- (v) **REFERENCES**
LANDMESSER, C. 1977: Evaluation of Potential Hydrocarbon Occurrence in the Solomon Islands. *S. Pacif. mar. geol. Notes* 1(5): 47-54.

CCSP-1/SI.12: Surveys of Polkington Trough and adjacent deep-sea areas to investigate the possible occurrence of manganese nodules (Priority B).

- (a) *Proposal:* TAG-VII (new project).

- (i) **BACKGROUND INFORMATION.** Deep-sea areas south of Guadalcanal and the Western Solomons are deep enough for the formation of manganese nodules. If terrigenous and volcanic

sediments are not being carried to this region, the chances of finding manganese nodules are high. An echo-sounding and sediment sampling programme would show whether nodules are present in this little-sampled area.

- (ii) PROJECT OBJECTIVES. To find out whether manganese nodules occur in the deep-sea areas south of the Solomons and in the Polkington Trough region.
- (iii) ECONOMIC TARGET. To establish the quantity and quality of any manganese nodule deposits found.

CCSP-1/SI.13: Survey of the Rennell Arc to establish hydrocarbon potential (Priority B).

(a) Proposal: TAG-VII (new project).

- (i) BACKGROUND INFORMATION. In the region of the Rennell Arc there are sediment thicknesses and folded structures which indicate the possibility of hydrocarbon occurrence. Few seismic reflection tracks have been run, and more data are needed to establish whether this area has potential for hydrocarbon occurrence.
- (ii) PROJECT OBJECTIVES. To carry out sufficient reconnaissance exploration to establish whether this area has potential for hydrocarbons.
- (iii) ECONOMIC TARGET. To evaluate the hydrocarbon potential of the Rennell Arc and adjacent areas.
- (v) REFERENCES
LANDMESSER, C.W. 1975: "Submarine geology of the eastern Coral Sea Basin, South-west Pacific." Unpubl. M.Sc. thesis, University of Hawaii. 64 pp.
LANDMESSER, C.W.; ANDREWS, J.E.; PACKHAM, G.H. 1975: Aspects of the geology of the eastern Coral Sea and western New Hebrides Basin. Pp. 647-62 in J.E. ANDREWS, G. PACKHAM *et al.*, "Initial Reports of the Deep Sea Drilling Project," Vol. 30. Washington, D.C.

(d) Field Operations: To be partly filled by survey by UNDP charter vessel in early 1979.

CCSP-1/SI.14: The potential of precious corals, especially *Corallium* species, in the Solomon Islands (Priority A).

(a) Proposal: TAG-VII (new project).

- (i) BACKGROUND INFORMATION. A preliminary survey by a Japanese private company has found fragments of *Corallium* in several localities throughout the Solomon Island Chain. An exception is the Santa Cruz Islands, where no work has been attempted. However, none of these sites have been surveyed in detail, and many other sites probably remain to be discovered, since the preliminary survey was very brief and of limited coverage.
- (ii) PROJECT OBJECTIVES. To find precious coral (*Corallium*) beds and evaluate their resource potential.

- (iii) ECONOMIC TARGET. To establish whether there is sufficient *Corallium* in Solomon Island waters on which to base a precious coral industry.

- (iv) RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY. The precious coral resource development is part of the Fisheries Programme in the 5-year Development Plan (1975-1980).

- (v) REFERENCES. Gem coral file, 1978, Fisheries Division, Honiara.

(b) Planning: Assess the results of the preliminary precious coral survey.

CCSP-1/SI.15: Bathymetric mapping of Solomon Islands (Priority A).

(a) Proposal: TAG-VII (new project).

- (i) BACKGROUND INFORMATION. The preparation of detailed bathymetric maps must be regarded as the main prerequisite before a rational prospecting programme can be planned. Considerable raw bathymetric data have been collected during hydrographic surveys, by scientific expeditions, and by private companies carrying out seismic reflection surveys. Most of these data are held by the U.K. Navy Hydrographer, the Hawaii Institute of Geophysics, or Geology Division, MNR, Honiara.

- (ii) PROJECT OBJECTIVES. To produce a series of bathymetric maps of the Solomon Islands on a scale of 1:500,000 (contour interval 100 m), with initial emphasis on those sheets covering the islands of the Western District; to produce other bathymetric maps on a larger scale where such detailed maps are required.

- (iv) RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY. In 1978 the Solomon Islands Government is reviewing the ordinance relating to offshore prospecting, and, in particular, to petroleum production. It is hoped in the long term to encourage the development of offshore mineral resources. The preparation of base maps showing bathymetry is a fundamental requirement in the process of stimulating offshore prospecting activities.

- (v) REFERENCES

KROENKE, L.W.; ORWIG, T.L. 1970: Bathymetric chart of the Ontong Java Plateau North of the Solomon Islands. 1:1,000,000 (approx.). Chart 1, South. Hawaii Institute of Geophysics, Hawaii.

LANDMESSER, C.W. 1974: Bathymetric chart of the Eastern Coral Sea Basin, South-west Pacific Ocean. 1:2,000,000 (approx.). Hawaii Institute of Geophysics, Hawaii.

MAMMERICKX, J.; CHASE, T.E.; SMITH, S.M.; TAYLOR, I.L. 1974: Bathymetry of the South Pacific. 1:6,500,000 (approx.). Charts 11 and 12. Scripps Institution of Oceanography.

UDINTSEV, G.B. (Ed.) 1964: Pacific Ocean. 1:10,000,000. Bathymetry in 6 sheets. Sheets 4 and 5. Moscow.

- Also: HMS *Hydra* surveys 1972-73 in Western Solomons, 1:100,000. Local surveys, Hydrographic Office, Marine Division, MWPU, Honiara.
- (b) *Planning*: Compilation of all available existing data.

TONGA

CCSP-1/TG.1: Seabed investigations for manganese nodules on the deep submarine shelf on the east side of Tonga Platform (Priority A).

- (a) *Proposal*: TAG-I.
- (ii) **PROJECT OBJECTIVES.** To determine possible occurrence of manganese nodules on the broad terrace on the eastern slope of the Tonga Platform at a depth of 3,000 to 4,000 metres.
- (c) *Preparations*: Survey time is programmed for November 1978.

CCSP-1/TG.2: Assessment of possibilities for occurrence of seabed phosphorites on and in the vicinity of the Tonga Platform (Priority B).

- (a) *Proposal*: TAG-I.
- Revision*: as follows.
- (i) **BACKGROUND INFORMATION.** Phosphorites occur on narrow, current-swept platform areas (e.g., Lau Ridge), and may occur on the Tonga Platform. Most likely localities are where bottom currents are too strong for sediment accumulation and where phosphatised limestone outcrops on the sea floor.
- (ii) **PROJECT OBJECTIVES.** To identify areas where phosphorite may occur on the Tonga Platform from bathymetry and ocean current data; to sample these areas, and determine the quantity and grade of any phosphorite deposits found.
- (iii) **ECONOMIC TARGET.** To establish the potential of phosphorite deposits on the Tonga Platform.
- (v) **REFERENCES**
- COOK, P.J. 1975: Prospects for finding offshore phosphate deposits in the south-west Pacific. Pp. 75-85 in ANON., Proceedings of the Third Session of CCOP/SOPAC, Apia, Western Samoa, September 1974.
- (b) *Planning*: To identify and evaluate potential areas of phosphorite resources from review of bathymetry and ocean current data.

CCSP-1/TG.3: Survey of near-shore areas for precious coral occurrence (Priority A).

- (a) *Proposal*: TAG-V.
- Revision*: as follows.
- (i) **BACKGROUND INFORMATION.** Deep-water precious coral (*Corallium*) occurs in the South Pacific (e.g., Western Samoa and American Samoa). *Corallium* species and other deep-water jewel corals are found on rocky bottoms between 100 m and 500 m water depth and where currents (usually tidal) are strong. Such conditions occur along the Tonga Platform between Vavau and Tongatapu and between Tongatapu and Eua.

- (ii) **PROJECT OBJECTIVES.** To locate beds of deep-water precious corals, especially *Corallium* species; to establish the quantity and quality of material present; to review the situation of black coral harvesting in Tonga, and evaluate the quantity and quality of this resource.

- (iii) **ECONOMIC TARGET.** To establish the potential of precious (jewel quality) corals in Tonga.

- (v) **REFERENCES**

GRIGG, R.W. 1976: Fisheries management of precious corals in Hawaii. *Sea Grant Technical Report UNIHI-SEAGRANT-TR-77-03*: 48 pp.

GRIGG, R.W. 1971: Status of the precious coral industry in Japan, Taiwan and Okinawa. *1970 Sea Grant Advisory Report UNIHI-SEAGRANT-AR-71-02*: 12 pp.

- (b) *Planning*: Potential sites are to be selected from bathymetry and current information.
- (c) *Preparations*: Survey time is programmed for November 1978.
- (d) *Field Operations*: Piha Channel precious coral survey (TG.78-1).
- (e) *Reports*: NR/CCOP/SOPAC(7)/CR.30 and 1.

CCSP-1/TG.4: Survey for zones of metalliferous enrichment in active volcanic areas (northern Tofua Ridge) (Priority B).

- (a) *Proposal*: see TAG-V.
- (i) **BACKGROUND INFORMATION.** Metalliferous sediments of submarine hydrothermal origin have occasionally been reported in island-arc complexes. Iron, manganese, and some minor element enrichments were described, for example, from sediments on the submarine Bonu Wahu volcano, Indonesia (Zelenov 1964). Submarine volcanic activity is not uncommon along the Tofua Ridge, which lies to the west of the Tonga Platform and extends southward from approximately 15°S through Tonga to New Zealand.
- (ii) **PROJECT OBJECTIVES.** To find pockets of sediment associated with active submarine volcanism, and identify any minerals concentrated in those sediments; to evaluate the potential of these deposits by analysing for Mn, Fe, Cu, Pb, Zn, Ni, Co, Ca, and Al.
- (iii) **ECONOMIC TARGET.** Assessment of potential for metalliferous sediments on the Tofua Ridge.
- (v) **REFERENCES**
- CRONAN, D.S. 1978: Regional geochemical reconnaissance survey for submarine metalliferous sediments in the southwestern Pacific Ocean - a preliminary note. *Trans. Inst. Min. Metall.* 87: B87-9.
- (b) *Planning*: Compilation of bathymetric data in areas of known submarine volcanic activity. Selection of target areas for survey work.

CCSP-1/TG.5: Seismic reflection survey of the Tonga Platform to determine sediment thickness and basement structure, with particular reference to oil production potential (Priority A).

(a) *Proposal*: see TAG-VI.

(i) **BACKGROUND INFORMATION.** The discovery of oil seeps on Tongatapu, and a reinterpretation of seismic reflection profiles, have led to exploration for oil and the drilling of five holes on Tongatapu. Exploration licenses are current for the Tonga Platform from Vavau and Tongatapu. South of Tongatapu the Tonga Platform at 1000 m extends southward to approximately 26°S. ORSTOM have collected seven east-west profiles over this southern part of the ridge.

(ii) **PROJECT OBJECTIVES.** To obtain extra seismic reflection lines over the southern part of the Tonga Platform between Tongatapu and latitude 26°S; to assess the hydrocarbon potential of this part of the Tofua Ridge from these and existing data.

(iii) **ECONOMIC TARGET.** To assess the hydrocarbon potential of the southern part of the Tonga Platform.

(iv) **RELATIONSHIP OF PROJECT TO MINERAL DEVELOPMENT POLICY.** It is the policy of the Government of the Kingdom of Tonga to give maximum encouragement to oil exploration in Tonga.

(v) **REFERENCES**

TONGILAVA, S.L.; KROENKE, L. 1975: Oil prospecting in Tonga 1968-1974. *S. Pacif. mar. geol. Notes 1(1)*: 1-8.

KROENKE, L.; TONGILAVA, S.L. 1975: A structural interpretation of two reflection profiles across the Tonga Arc. *S. Pacif. mar. geol. Notes 1(2)*: 9-16.

ORSTOM 1977: Participation of French research organizations in the study of marine geology-geophysics in the South Pacific, 1977. Conference document, Sixth Session of CCOP/SOPAC, October 1977, Port Moresby, Papua New Guinea.

(b) *Planning*: Compilation of bathymetric data, and review of existing seismic reflection data.

(d) *Field Operations*: Partly filled by ORSTOM cruises in 1977.

CCSP-1/TG.6: Reconnaissance inventory of beach and near-shore sand for landfill, construction, and roading, and determination of beach sand resources and renewal rates (Priority A).

(a) *Proposal*: see TAG-VI.

Revision: as follows.

(i) **BACKGROUND INFORMATION.** The beaches around Tongatapu are few and small. However, they provide the island with most of its sand for roading, construction, and graves. According to local residents most beaches renew themselves once mining has ceased. The lagoons are very narrow, shallow, and sediment-free, and the sand appears to be derived directly from the reef. With growth of the tourist industry there is an increasing need both for more sand and to preserve the beaches for recreation purposes.

(ii) **PROJECT OBJECTIVES.** To determine the quantity and grade of sand on beaches and near shore around Tongatapu and adjacent small islands - Lifuka in Haapai and Neifu in Vavau; to establish sources of this sand, transport patterns, and renewal rates of selected beaches.

(iii) **ECONOMIC TARGET.** To manage mining of beach sand so that Tonga's future needs are met with least possible damage to the environment.

(d) *Field Operations*: Nuku'alofa harbour sand survey (TG.78-1). Regular beach surveys, started July 1978, are to continue for at least two years.

(e) *Reports*: NR/CCOP/SOPAC(7)/CR.26 and 30.

REGIONAL PROJECTS

CCSP-1/REG.1: Marine geologic and geophysical investigations in the Solomon and Coral Seas (Priority B).

(a) *Proposal*: see TAG-I.

(d) *Field Operations*: Partially filled by joint cruises on r.v. *Sonne* in 1978.

(e) *Reports*: NR/CCOP/SOPAC(7)/CR.6.

CCSP-1/REG.2: Marine geologic and geophysical investigations in the area of Ontong Java, Ellice, and Santa Cruz Islands (Priority B).

(a) *Proposal*: see TAG-I.

CCSP-1/REG.3: Marine geologic and geophysical investigations of the northern part of the Fiji Plateau, from Samoa to the northern New Hebrides and Santa Cruz Islands (Priority A).

(a) *Proposal*: see TAG-I.

CCSP-1/REG.4: Marine geologic and geophysical investigations of the Fiji Plateau (Priority A).

(a) *Proposal*: see TAG-I.

CCSP-1/REG.5: Marine geologic and geophysical investigations of the Lau Basin (Priority B).

(a) *Proposal*: see TAG-I.

(d) *Field Operations*: Partially filled by ORSTOM cruise.

(e) *Reports*: NR/CCOP/SOPAC(7)/CR.29.

CCSP-1/REG.6: Regional geologic evaluation to determine additional ocean drilling sites in the South Pacific region (Priority A).

(a) *Proposal*: see TAG-I.

CCSP-1/REG.7: Surveys of abyssal sediment cover north and east of New Zealand (Priority A).

- (a) *Proposal:* see TAG-II.
- (d) *Field Operations:* No further field work planned.
- (e) *Reports:* NR/CCOP/SOPAC(7)/CR.29.

CCSP-1/REG.8: Distribution of shelled plankton in water column and sediments of South Fiji Basin (Priority A).

- (d) *Field Operations:* No further field work planned.

CCSP-1/REG.9: Seismic profiling and bottom sampling between northern New Caledonia and Ontong Java Plateau (Priority A).

- (a) *Proposal:* see TAG-I.

CCSP-1/REG.10: Search for metalliferous muds and hot brines in enclosed oceanic basins (Priority A).

- (a) *Proposal:* see TAG-III.
- (b) *Planning:* Cruise planned by NZOI for 1980.

CCSP-1/REG.11: Search for phosphate on seamount surfaces in equatorial areas of the South Pacific (Priority B).

- (a) *Proposal:* see TAG-III.

CCSP-1/REG.12: Search for manganese nodules in the Ontong Java - Ellice Basin area (Priority B).

- (a) *Proposal:* see TAG-IV.

CCSP-1/REG.13: Search for manganese nodules along a Cook Islands - Tuamotu transect (Priority B).

- (a) *Proposal:* see TAG-IV.
- (d) *Field Operations:* Combined ORSTOM/BGR (Federal Republic of Germany) cruise on R/V *Sonne* carried out in 1978.

CCSP-1/REG.14: Compilation of chemical analyses of sediments in the South Pacific region (Priority A).

- (a) *Proposal:* see TAG-IV.
- (e) *Reports:* Report for phase I in press.

CCSP-1/REG.15: Compilation of manganese nodule data (Priority A).

- (a) *Proposal:* see TAG-IV.
- (b) *Planning:* Combined NZOI and SIO work continuing.

CCSP-1/REG.16: The study of energy release and seismicity in the South-west Pacific region (Priority A).

- (a) *Proposal:* see TAG-IV.
- (d) *Field Operations:* Continuing.
- (e) *Reports:* NR/CCOP/SOPAC(7)/CR.33.

CCSP-1/REG.17: Regional data and syntheses (Priority A).

- (a) *Proposal:* see TAG-IV.

CCSP-1/REG.18: Ocean thermal data collection (Priority B).

- (a) *Proposal:* see TAG-IV.
- (b) *Planning:* Data collection planned during CCOP/SOPAC offshore surveys in 1978.

CCSP-1/REG.19: Study of the tectonics of the Fiji Plateau area using OBS and other marine geophysical survey techniques (Priority A).

- (a) *Proposal:* see TAG-V.

CCSP-1/REG.20: Investigation of seismicity of the Samoa - Tonga - Cook Islands region (Priority A).

- (a) *Proposal:* see TAG-V.

ANNEX III

LIST OF DOCUMENTS

Document no. and agenda item	Title	Submitted by
NR/CCOP/SOPAC (7)/L.1	Provisional agenda	ESCAP Secretariat
NR/CCOP/SOPAC (7)/1 Item 2b	Review of activities of the ESCAP Secretariat since the Sixth Session	ESCAP Secretariat
NR/CCOP/SOPAC (7)/2 Item 7	Nitrogen Fertilizer Generator for Small Farms or Localized Farm Areas	Technical Secretariat
NR/CCOP/SOPAC (7)/3 Item 7	Phosphorite Prospecting using a Submersible Scintillation Counter	Technical Secretariat
NR/CCOP/SOPAC (7)/4 Item 8	Developments on Manganese Nodules/Crusts	Technical Secretariat
NR/CCOP/SOPAC (7)/5 Item 9a	Ocean Thermal Energy Conversion (OTEC)	Technical Secretariat
NR/CCOP/SOPAC (7)/CR.1 Item 3a	Cruise Report: Black Coral in Tongan Waters	P.J. Hill <i>et al.</i> (Technical Secretariat)
NR/CCOP/SOPAC (7)/CR.2 Item 3a	Progress on New Zealand's National and Regional Projects	K.B. Lewis (New Zealand)
NR/CCOP/SOPAC (7)/CR.3 Item 3a	Distribution, Composition, and Age of Submarine Phosphorites on Chatham Rise, east of New Zealand	D.J. Cullen (New Zealand)
NR/CCOP/SOPAC (7)/CR.4 Item 13	Terms of Reference of the Committee for Co-ordination of Joint Prospecting for Mineral Resources in South Pacific Offshore Areas (CCOP/SOPAC)	ESCAP Secretariat
NR/CCOP/SOPAC (7)/CR.5 Item 3a	Cruise Report: Rarotonga Near-shore Survey	K.B. Lewis <i>et al.</i> (Technical Secretariat)
NR/CCOP/SOPAC (7)/CR. 6 Item 5	South Pacific Marine Geological Notes Vol. 1 No. 8: Marine Geology of eastern Coral Sea (eastern margin of Indo-Australian Plate, north of New Caledonia)	J. Daniel <i>et al.</i> (France)
NR/CCOP/SOPAC (7)/CR. 7 Item 7	Cruise Report: Mineral Resources Department 78-1	R.T.R. Wingfield (Fiji)
NR/CCOP/SOPAC (7)/CR.8 Item 12	CCOP/SOPAC — Member Country Project Status Sheet	Fiji
NR/CCOP/SOPAC (7)/CR.9 Item 3b	Report on Training Programme in Offshore Mineral Prospecting Techniques — r.v. <i>Hakurei Maru</i> Cruise 1978	E.J. Tupua (Fiji)
NR/CCOP/SOPAC (7)/CR.10 Item 12	Summary of Requested Aid from CCOP/SOPAC, end 1978 to 1981	Technical Secretariat
NR/CCOP/SOPAC (7)/CR.11 Item 8	South Pacific Marine Geological Notes Vol. 1 No. 7: Notes on the Surface Texture, Internal Structure, and Mineralogy of Manganese Nodules from the South Penrhyn Basin	G.P. Glasby (New Zealand)
NR/CCOP/SOPAC (7)/CR.12 Item 3a & 3b	Review of Survey Activities, Progress, Results, and Intentions	R.T.R. Wingfield (Fiji)
NR/CCOP/SOPAC (7)/CR.13 Item 5	CCOP/SOPAC Publications	Technical Secretariat

NR/CCOP/SOPAC (7)/CR.14 Item 6	Report on the Regional Training Courses in Basic Earth Science	R.J. Morrison (Fiji)
NR/CCOP/SOPAC (7)/CR.15 Item 3b	Report on Activities of CCOP/SOPAC Consultant Geologist for the period 6/2/78-8/5/78	H. Wittekindt (Technical Secretariat)
NR/CCOP/SOPAC (7)/CR.16 Item 3a	Proposed CCOP/SOPAC 1978 Field Programme (r.v. <i>Machias</i>)	Technical Secretariat
NR/CCOP/SOPAC (7)/CR.17 Item 3a & 3b	Survey Activities in the Solomon Islands	Solomon Islands
NR/CCOP/SOPAC (7)/CR.18 Item 8	1978 Progress Report on Oil Exploration Activity in Fiji Waters	R.N. Richmond (Fiji)
NR/CCOP/SOPAC (7)/CR.19 Item 6	Basic Earth Science Course, 1979/1980	R.J. Morrison (Fiji)
NR/CCOP/SOPAC (7)/CR.20 Item 8	Progress of Petroleum Exploration, Offshore New Zealand	H.R. Katz (New Zealand)
NR/CCOP/SOPAC (7)/CR.21 Item 8	Petroleum Exploration in Tonga	H.R. Katz (New Zealand)
NR/CCOP/SOPAC (7)/CR.22 Item 8	Developments in New Zealand and South-west Pacific Island Region in 1977	H.R. Katz (New Zealand)
NR/CCOP/SOPAC (7)/CR.23 Item 8	Mineral Resources of the New Zealand Offshore Region	H.R. Katz & G.P. Glasby (New Zealand)
NR/CCOP/SOPAC (7)/CR.24 Item 3a	Review of Activities of the Technical Secretariat since the Sixth Session	Technical Secretariat
NR/CCOP/SOPAC (7)/CR.25 Item 3a	Cruise Report: Apia Harbour Survey	A. John Halunen Jr (Technical Secretariat)
NR/CCOP/SOPAC (7)/CR.26 Item 3a	Sand Survey of the Beaches of Tongatapu	J.V. Eade <i>et al.</i> (Technical Secretariat)
NR/CCOP/SOPAC (7)/CR.27 Item 3b	Summary of Activities: September 1977 to September 1978	Papua New Guinea
NR/CCOP/SOPAC (7)/CR.28 Item 3a & 3b	Chemical Analysis Results about Metal Contents of Polymetallic Nodule Samples in the Cook Islands Archipelago	J. Recy <i>et al.</i> (France)
NR/CCOP/SOPAC (7)/CR.29 Item 3a & 3b	Preliminary Report on the EVA III Cruise 1977	J. Dupont (France)
NR/CCOP/SOPAC (7)/CR.30 Item 3a	Cruise Report: Nearshore Surveys off Tongatapu, Tonga, for Precious Corals and Sand, June 1978	J.V. Eade (Technical Secretariat)
NR/CCOP/SOPAC (7)/CR.31 Item 5	Proceedings of the Sixth Session of CCOP/SOPAC	Technical Secretariat
NR/CCOP/SOPAC (7)/CR.32	Soviet Geological - Geophysical Investigations in the South-west Pacific (Map)	U.S.S.R.
NR/CCOP/SOPAC (7)/CR.33 Item 3b	Summary of the ORSTOM/USA Joint Research Programme - Dynamics of the Southwest Pacific	U.S.A.
NR/CCOP/SOPAC (7)/CR.34 Item 8	Theoretical Prerequisites of Oil-Gas Fields in Deep-Sea Depressions of the Pacific Ocean Marginal Seas	L.E. Levin (U.S.S.R.)
NR/CCOP/SOPAC (7)/CR.35 Item 3b	Co-operative Study of the Kuroshio and Adjacent Regions/Western Pacific; Outline of Scientific Programmes for WESTPAC; Proposed Terms of Reference for WESTPAC	IOC

NR/CCOP/SOPAC (7)/CR.36 Item 8	Precious Coral PEACESAT Discussions and Workshop	J.V. Eade (Technical Secretariat)
NR/CCOP/SOPAC (7)/CR.37 Item 12	CCOP/SOPAC – Member Country Project Data Sheet	Papua New Guinea
NR/CCOP/SOPAC (7)/CR.38 Item 8	Report on the United Nations Expert Group Meeting on Sea-bed Mineral Resources Assessment	ESCAP Secretariat
NR/CCOP/SOPAC (7)/CR.39 Item 8	Annual Report on the United Nations Revolving Fund for Natural Resources Exploration	ESCAP Secretaria
NR/CCOP/SOPAC (7)/CR.40 Item 12	CCOP/SOPAC – Member Country Project Data Sheet	Solomon Islands
NR/CCOP/SOPAC (7)/CR.41 Item 12	CCOP/SOPAC – Member Country Project Data Sheet	New Hebrides
NR/CCOP/SOPAC (7)/CR.42 Item 12	CCOP/SOPAC – Member Country Project Data Sheet	Tonga
NR/CCOP/SOPAC (7)/CR.43 Item 12	CCOP/SOPAC – Member Country Project Data Sheet	Gilbert Islands
NR/CCOP/SOPAC (7)/CR.44 Item 12	CCOP/SOPAC – Member Country Project Data Sheet	Fiji
NR/CCOP/SOPAC (7)/CR.45 Item 12	CCOP/SOPAC – Member Country Project Data Sheet	Western Samoa
NR/CCOP/SOPAC (7)/CR.46 Item 12	CCOP/SOPAC – Member Country Project Data Sheet	Papua New Guinea
NR/CCOP/SOPAC (7)/CR.47 Item 12	CCOP/SOPAC – Member Country Project Data Sheet	Western Samoa

ANNEX IV

LIST OF MAPS, CHARTS, AND PUBLICATIONS

Cook Islands

1. Bathymetric survey map of Rarotonga Island, CCOP/SOPAC. 1978. Scale: 20 chains = 1 inch.

Fiji

1. Map showing mining and oil concession areas, Fiji. Geological Survey Department, Fiji. Scale: 1:500,000.
2. Seismic Reflection Profiles of Bligh Water.
3. Tectonic map, southwest quadrant, Circum-Pacific Map Project. 1978. Scale: 1:10,000,000.
5. Map showing the archipelagic basepoints, baselines, internal waters, and territorial seas of Fiji Islands. 1978. Scale: 1:800,000.
6. Hybrid satellite/omega navigation in the Mx 1105. 1978.

France

1. 200 nautical mile exclusive economic zones in the south, central, and western Pacific. CNEXO, ORSTOM. 1978.
2. French exploration seeks to define mineable nodule tonnages on Pacific floor. July 1977. E/MJ.
3. Les activités Françaises dans le domaine des nodules polymétalliques. Annales des Mines, 1977.

New Hebrides

1. Geology of South Santo. New Hebrides Geological Survey Sheet 4. 1977. Scale: 1:100,000.

New Zealand

1. DSIR Research 1975 and 1977.
2. Physiographic map of New Zealand. N.Z. Oceanographic Institute Chart, Miscellaneous Series 51. 1978. Scale: 1:4,000,000.
3. Oil prospective sedimentary basins in New Zealand (shows locations of wells drilled). N.Z. Geological Survey. 1978. Scale: 1:6,000,000.
4. List of Charts 1975. N.Z. Oceanographic Institute Miscellaneous Publication 64.
5. Publications to December 1977. N.Z. Oceanographic Institute Miscellaneous Publication 82.
6. NZOI Oceanographic Field Report No. 12: The Distribution of Submarine Phosphorite Deposits on Central Chatham Rise East of New Zealand. May 1978.
7. NZOI Oceanographic Field Report No. 11: Manganese Nodules and Associated Sediments from the Samoan Basin and Passage. February 1978.
8. Cook Bathymetry, 1:1,000,000. N.Z. Oceanographic Institute Chart, Oceanic Series. 1968.
9. A Bibliography of Offshore Islands of New Zealand. N.Z. Oceanographic Institute Miscellaneous Publication 80. 1977.

10. Turnagain Sediments. N.Z. Oceanographic Institute Chart, Coastal Series 1:200,000. 1970.

11. Cape Palliser to Cape Turnagain: A Bibliography. N.Z. Oceanographic Institute Miscellaneous Publication 78. 1977.

12. Tectonic Map of the Southwest Pacific. N.Z. Oceanographic Institute Chart, Miscellaneous Series 20. 1970.

13. Coastal Processes, Beach Morphology, and Sediments along the northeast coast of the South Island, New Zealand. N.Z. Journal of Geology and Geophysics 20 (1). 1977.

14. New Zealand Region Bathymetry. N.Z. Oceanographic Institute Chart, Miscellaneous Series 15. 1967.

15. Wellington Harbour Bathymetry. N.Z. Oceanographic Institute Chart, Miscellaneous Series 25. 1976.

16. Heated Effluent Discharge and its Effect on Marine Organisms. N.Z. Oceanographic Institute Miscellaneous Publication 76. 1976.

17. Non-linear mapping of regional geochemical variability of manganese nodules in the Pacific Ocean. Applied Earth Science. Extract from Transactions (Section B) of the Institution of Mining and Metallurgy, Vol. 86. 1977.

18. A Morphologic Guide to the Continental Oceanic Crustal Boundary around New Zealand. NZOI Oceanographic Summary No. 13. June 1977.

Solomon Islands

1. Honiara. Guadalcanal Geological Map Sheet GU 4. Ministry of Natural Resources, Solomon Islands. 1978. Scale: 1:50,000.
2. Choiseul Bay. Choiseul Geological Map Sheet CH 1. Ministry of Natural Resources, Solomon Islands. 1977. Scale: 1:50,000.
3. Chörovanga (Sirovanga). Choiseul Geological Map Sheet CH 2, Ministry of Natural Resources, Solomon Islands. 1977. Scale: 1:50,000.

Tonga

1. Geological Well Sections Kumifonua 1 and 2 from Tongatapu, Tonga.
2. Lavengatonga — Beach Inventory. Scale: longitudinal $\times$ plan 1:200; vertical 1:200, cross-section 1:200.
3. Planimetric Map. Tongatapu Island. 1971. Scale: 1:500,000.
4. Track chart of Mobil Oil Corporation Geophysical Survey 1972, Tonga to Fiji.
5. Tonga Precious Coral Project CCSP-1/TG.3. Ministry of Lands, Survey, and Natural Resources, Tonga. 1978. Scale: 1:25,000.
6. Tonga Sand and Gravel Project CCSP-1/TG.6. Kolovai Beach — Sand Inventory. 1978. Scale: longitudinal $\times$ plan 1:200; vertical 1:200.

United Kingdom

1. Seabed Gamma-ray Spectrometer. IGS. 1977.
2. "SMARTIE" Microcomputer-controlled underwater inspection system. IGS. 1978.
3. 6" Diver-operated Jet Pump Dredge. Alluvial Mining (U.K.) Ltd. 1978.

United States

1. Index to LANDSAT Coverage, Oceania IOPS-5, Ed. 1, August 1972 - July 1974. USGS. 1975.
2. Volcano Surveillance Program for the Pacific Ocean Areas and Margins. U.S. Government Printing Office.
3. The Future of Scientific Ocean Drilling. JOIDES. Department of Oceanography, University of Washington, Seattle, Washington 98195. 1977.
4. United States Geological Survey Yearbook, Fiscal Year 1977.
5. Training Course in Hydrologic Techniques for International Participants, April 23 - May 23, 1979. USGS.
6. Geographic Map of the Circum-Pacific Region, Southwest Quadrant. 1978. 1:10,000,000.
7. Maps Illustrating Various Formulae for the definition of the Continental Shelf. United Nations Third Law of the Sea Conference. 1:3,000,000.
8. Transit Satellite System. Facts Sheet on U.S. Weather and Earth Observation Satellite. 1978.
9. Earth Sciences and the Urban Environment; How much water in a 12-ounce can?; The future of earthquake prediction; Outer continental shelf safety in oil and gas operations; Estimates of undiscovered petroleum resources - a perspective. Reprinted from USGS Annual Report, Fiscal Year 1975.

Hawaii Institute of Geophysics

1. Publications 1978.
2. Hawaii's Precious Corals. By Richard W. Grigg.
3. Biennial Report 1973-75.
4. Hawaii Geothermal Project, Well Completion Report HGP-A. 1976.
5. The Natural Energy Laboratory of Hawaii Annual Report. 1977.
6. Hawaii Natural Energy Institute Annual Report. 1977.
7. Summary - Geothermal Energy in Hawaii. Hawaii Geothermal Project, Hawaii Energy Institute, University of Hawaii. January 1978.
10. Nature to be Commanded ... Earth Science Maps Applied to Land and Water Management. Geological Survey Professional Paper 950. USGS. 1978.
11. Earth Resource Observation System (EROS) Program. 12th and 13th International Remote Sensing Workshops, April 30 - May 25 and Sept. 10 - Oct. 5, 1979.
12. Advanced Training of Foreign Participants in Remote Sensing. U.S. Department of the Interior Geological Survey. 1978.

USSR

1. Soviet Geological Geophysical Investigations in S.W. Pacific (1968-1977).
2. Geographic and Bathymetric Map of the World Oceans. USSR. 1977. 1:40,000,000.
4. Geological Geophysical Atlas of the Indian Ocean. International Indian Ocean Expedition. Academy of Science, USSR. 1975.
5. Gravity Map of the Pacific Ocean and the Pacific Mobile Belt. Bouger Anomalies. USSR. 9 sheets. 1976. 1:10,000,000.
6. Gravity Map of the Antarctic. Free Air Anomalies. USSR. 5 sheets. 1:5,000,000.

ESCAP

1. Sedimentary Basins of the ESCAP Region (Sheet S-4, Sheet S-3). Preliminary Edition, IGCP Project No. 32. ESCAP Secretariat. 1977. Scale 1:10,000,000.

IOC

1. Manual on International Oceanographic Data Exchanges, UNESCO. 1976.
2. Report of the IOC/FAO (IPFC)/UNEP International Workshop on Marine Pollution in East Asian Waters. UNESCO. 1976.
3. Pollution in the Marine Environment. UNESCO. 1978.
4. A Comprehensive Plan for the Global Investigation of Pollution in the Marine Environment and Baseline Study Guidelines. UNESCO. 1976.
5. Guide for Establishing a National Oceanographic Data Centre. UNESCO. 1976.
6. Guide to Operational Procedures for the IGOSS Pilot Project on Marine Pollution (Petroleum) Monitoring. UNESCO. 1976.
7. Guide to International Marine Environmental Data Service. UNESCO. 1975.
8. Manual for Monitoring of Oil and Petroleum Hydrocarbons in Marine Waters and on Beaches. UNESCO. 1977.
9. Tsunami Warning in the Pacific.
10. Aquatic Science and Fisheries Information System. FAO/UNESCO.
11. General Bathymetric Chart of the Oceans.
12. Intergovernmental Oceanographic Commission. UNESCO/IOC.

Technical Secretariat

1. Submersible Scintillation Counter. 1978.
2. Proposed Conference on Fertiliser Flows of the Asia-Oceania-South Pacific Region. 1978.
3. Bibliography of Geology and Geophysics of the South Pacific. Technical Bulletin No. 1.
4. Papers presented at the IDOE Workshop, Suva, Fiji, 16 September 1975. Technical Bulletin No. 2.

5. Committee for the Co-ordination of Joint Prospecting for Mineral Resources in South Pacific Offshore Areas (CCOP/SOPAC) (3rd, 4th, and 5th Sessions).
6. South Pacific Marine Geological Notes, Vol. 1. Nos. 1-8.

7. Nitrogen Fertilizer Generator. 1978.
8. Manganese Nodules/Crusts. Ocean Mining. 1978.
9. OTEC. 1978.

APPENDIX I

LIST OF PARTICIPANTS

Member Governments of CCOP/SOPAC

Cook Islands		Dr Hans Rudolf Katz Chief Petroleum Geologist New Zealand Geological Survey P.O. Box 30368 Lower Hutt
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Mr Glenn Shepherd	Consultant Petroleum Geologist CCOP/SOPAC Technical Secretariat c/o Mineral Resources Department Private Mail Bag GPO Suva Fiji

PART 2. DOCUMENTATION

A. CCOP/SOPAC Agencies' reports for 1977-78

1. REVIEW OF THE ESCAP SECRETARIAT'S ACTIVITIES SINCE THE SIXTH SESSION

(Document NR/CCOP/SOPAC (7)/1)

Note by the ESCAP Secretariat

(a) As was the case last year, the activities of the ESCAP Secretariat since the Sixth Session have been largely directed towards submitting proposals and securing funds for project activities and arranging for recruitment of personnel, ship charter, and acquisition of equipment.

(b) At its Sixth Session the Committee was informed of the advice from the United Nations Development Programme (UNDP) that the allocation to the project in 1978 would be \$250,000 and that representations had been made to UNDP to have that figure reconsidered. On 12 December 1977 advice was received that the allocation would remain at \$250,000, which included any New Zealand non-convertible funds.

(c) On 16 December, after correspondence with the UNDP office in Suva and the project office, a revised budget for a four-year project, based on recommendations made at the Sixth Session, was submitted to UNDP for consideration. On 13 March 1978 ESCAP was advised that the allocation of \$250,000 for 1978 had been approved, so that expenditure against that amount could begin. At the same time advice was received that it was proposed to field another mission to assess the situation before entering into any further commitment on the project.

(d) The urgency associated with fielding this mission was impressed on UNDP headquarters on a number of occasions, and the favourable outcome, now known to all participants, will be a principal item for consideration at the Seventh Session.

(e) In the meantime, late in 1977 the Secretariat was advised that an allocation of \$A70,000 for CCOP/SOPAC was being made by the Australian Government, and would be available during 1978. Actual transfer of funds took place in January 1978, and this has been the main factor enabling timely acquisition of equipment for the current year's programme.

(f) Although the timing of the Seventh Session has proved somewhat awkward from the point of view of planning the survey cruise programme, arrangements for ship charter proceeded fairly satisfactorily, and certainly without the traumas which accompanied their process the previous year. Funds for the ship charter have been suballotted to ESCAP, and this should also help to avoid problems regarding payment, some of which are not yet fully resolved in relation to last year's programme.

(g) In addition, approval was obtained for the purchase of non-expendable geophysical and navigational equipment totalling over \$60,000; arrangements were made for the services of a specialist, provided on a non-reimbursable basis by the Government of the Federal Republic of Germany, to assist the authorities in Fiji for a three-month period in the preparation of the south-west quadrant of the circum-Pacific map project; a consultant petroleum geologist was recruited for a five-month assignment to the project; and arrangements were made for a technician from Fiji to participate in a research cruise by the Geological Survey of Japan, with the expectation that a similar arrangement would be made in 1979 for a technician of a member country. As proposed in correspondence with members during the year, an invitation was extended to the Norwegian Government to send a technical adviser to the Seventh Session; at this stage a formal response had not been received.

(h) As indicated above, there has been some improvement in administrative arrangements related to this project, and this whole matter will receive careful consideration in the context of the UNDP project, which is expected to be approved in the very near future. In this connection, it will be necessary to consider, under agenda item 13, the implications of the new project for the terms of reference of CCOP/SOPAC. As mentioned at the Sixth Session, the whole question of the status of intergovernmental projects within the United Nations system is being reviewed, but a final determination has not yet been made. The draft project document is being examined, and it is hoped that some further notes will be provided on this matter at the meeting.

(i) In order to assist liaison and co-operation between the various activities in the minerals field carried out under ESCAP auspices, meetings of representatives of the various projects and of the Mineral Resources Section of the Natural Resources Division are held twice a year. The most recent meeting was held in March 1978, immediately after the thirty-fourth session of the Commission.

2. REVIEW OF ACTIVITIES OF THE CCOP/SOPAC TECHNICAL SECRETARIAT SINCE THE SIXTH SESSION

(Document NR/CCOP/SOPAC (7)/CR.24)

Note by the CCOP/SOPAC Technical Secretariat

Following the Sixth Session, Dr Loren Kroenke visited the Kingdom of Tonga to provide consultative services as a Petroleum Geologist and

returned to Hawaii. Dr Chujo returned to Japan. In November Mr Halunen travelled to Bangkok to attend the Project Managers' Meeting. Mr Eade visited New Zealand to inspect the M/V *Picton* as a possible vessel for charter in 1978, and travelled to Sydney, Australia, to attend the Geodynamics Conference. During December, Mr Eade and Mr Halunen were preparing the 1978 budget and work programme.

In mid January, Mr Halunen and Mr Eade assisted in the Basic Earth Sciences Course held at the University of the South Pacific. During preparatory lectures a four-day cruise aboard the USP fisheries research vessel was planned. The vessel left Suva, Fiji, with seventeen students and four adults, arrived at the island of Ovalau, and then proceeded to survey the region to the north and east of Ovalau. The students were divided into two groups, each spending one day at sea collecting data and samples in the survey area. At the completion of the cruise the Technical Secretariat personnel conducted several lectures and laboratory sessions, working up the data collected during this cruise. Each student completed a cruise report as the final exercise.

In January and February 1978 Mr Halunen travelled to Western Samoa to organise the cruise planned for April. He then visited the Cook Islands to co-ordinate the survey scheduled for May, and travelled to Wellington to discuss the proposed participation of NZOI personnel and equipment in the Cook Islands and Tonga Surveys and visit the *Picton*, a possible charter vessel for the 1978 field season. While in Wellington Mr Halunen visited several possible meeting sites being considered for the Seventh Session. He then travelled to Tonga to make initial arrangements for the Tonga Offshore Survey.

During the first three months of 1978 several Precious Coral Seminars were held via the Peace Satellite Communications network. These sessions were organised and chaired by Jim Eade, and many countries of the South Pacific took part. The principal information source was Dr Richard Grigg of Hawaii. Early in February the project acquired the services of Mr Pat Fuata as a marine technician. Halunen returned to Suva on 13 February. On 25 February Halunen departed for the Project Managers' Meeting at ESCAP Bangkok, en route visiting the New Hebrides, Gilbert Islands, and Nauru and attending the Geodynamics Conference in Tokyo. During the return trip from Bangkok, Halunen visited the

Solomon Islands and New Hebrides, where a meeting was held to discuss procedures necessary for the New Hebrides Government to join CCOP/SOPAC. Halunen returned to Suva in early April.

On 17-19 April, Mr Halunen and Mr Eade travelled to Tonga and attended a Precious Coral Meeting organised by the Technical Secretariat. This meeting will be discussed later (see next item). On 20 April, while still in Tonga, Mr Halunen and Mr Eade arranged for a boat to be used for the side-scan sonar sand survey and the precious coral surveys which were being planned for May and June in Tonga. On 20 April Mr Halunen and Mr Eade returned to the Suva office.

The next day Halunen departed for Western Samoa to take part in the Apia Harbour Survey and the Western Samoa Precious Coral Surveys and returned to Suva on 11 May. In mid May Dr Keith Lewis travelled to the Cook Islands with Mr Peter Hill, Electronics Technician from NZOI, to conduct a survey around Rarotonga using the NZOI side-scan sonar. In early June Lewis and Hill travelled to Tonga, and were joined by Jim Eade to conduct a precious coral survey of Piha Channel. In mid June this survey was completed, and the survey team returned to their respective bases.

In mid June the UNDP Technical Review Mission arrived to review the programme of the Technical Secretariat and make recommendations for the future of the project. Following the endorsements of this report and the Project Document recommended by the mission, these documents were disseminated to the member country representatives for their consideration.

Mr Halunen and Mr Eade travelled to the Circum-Pacific Energy Conference in Honolulu in late July. Mr Halunen returned directly to Suva; Mr Eade continued to the Solomon Islands and Papua New Guinea to discuss and elaborate upon their respective work programmes.

Note: Other documents presented relating to activities of CCOP/SOPAC agencies are:

NR/CCOP/SOPAC (7)/CR.4, the terms of reference of CCOP/SOPAC, which are printed in the Proceedings of the First Session of CCOP/SOPAC (Annex 6); and

NR/CCOP/SOPAC (7)/CR.16, the proposed field programme for the UNDP charter vessel in 1978 (see paragraph 89, Seventh Session TAG Report).

B. Publications of CCOP/SOPAC

Note: The following publications were presented. "Proceedings of the Sixth Session of CCOP/SOPAC" (advance copy) (document NR/CCOP/SOPAC (7)/CR.31), and two issues of *South Pacific Marine*

Geological Notes (documents NR/CCOP/SOPAC (7)/CR.6 and CR.11).

A full list of CCOP/SOPAC publications was presented (document NR/CCOP/SOPAC (7)/CR.13).

C. International meetings

3. PRECIOUS CORAL : A REVIEW

(Document NR/CCOP/SOPAC (7)/CR.36)

James V. Eade

CCOP/SOPAC Technical Secretariat

Introduction

During the 1977 CCOP/SOPAC cruises in Western Samoa, the Cook Islands, and Tonga a few dredge hauls were made for deep-water precious corals. The results of these cruises were negative, but from the experience gained it was obvious that we, at the Technical Secretariat, needed to know much more about precious corals, especially their distribution and the way they are collected. Subsequently, at the Sixth Session of CCOP/SOPAC in Port Moresby during October 1977, the Technical Secretariat was requested to seek the services of an expert consultant to advise member countries on the economic potential of precious coral. Early in 1978 the services of Dr Richard Grigg, Hawaii Institute of Marine Biology, were sought. While preparations were being made for a meeting with Dr Grigg, information exchange sessions were organised using the PEACESAT (Pan Pacific Educational and Communication Experiments by Satellite) Network. Four sessions were held in the first six months of 1978. At these sessions, which were chaired by the CCOP/SOPAC Technical Secretariat in Suva, Dr Richard Grigg provided much useful information on the biology, distribution, harvesting, and use of precious coral in the Pacific.

In April 1978 a three-day workshop was held in Nuku'alofa to cover all aspects of precious corals, and to evaluate their potential as an economic resource in the South Pacific. Representatives from Western Samoa, the Cook Islands, Tonga, and the CCOP/SOPAC Technical Secretariat met with Dr Grigg, who had brought with him visual material to illustrate the industry in Hawaii. Underwater photographs and samples of both raw coral and coral jewellery were displayed at the workshop. Following discussions which were generated by the presentation of this material, charts of Western Samoa, the Cook Islands, and Tonga were examined for sites where precious corals might occur. Before the meeting finished a list of conclusions from the meeting was prepared. These are presented as Appendix 1. During the discussions on the PEACESAT Network and at the Workshop in Nuku'alofa, all aspects of the current use of precious corals were discussed. Most of the information was provided by Dr Grigg; however, several important items of information on precious coral distribution in the South Pacific came to light as the result of these discussions.

Definitions

The term 'precious coral' (sometime referred to as 'jewel coral') classically refers to the red

corals of commerce. In this report the term is used to describe those corals whose skeleton is the raw material of the coral jewellery industry. As well as the red corals, these include the white and pink varieties and the non-calcareous black and gold species. For convenience, precious corals fall into two groups - the shallow-water species, which live in depths where they can be collected by scuba diving; and the deeper-water species, which live in water beyond these depths, where they can be collected only by dredging or by submersibles. All these corals have one factor in common: they are hard and dense enough to take and hold a good polish. Hardness ranges from 2.5 to 4.0 on the Mohs scale.

History and Use

Skeletons of precious corals have been an object of curiosity and commerce to man for thousands of years; commercial activity in the Mediterranean Sea may have started as much as 7000 years ago. Here red coral has been the prize form, and this has been collected by free diving, dredging, and more recently by submersible. The history of a coral industry in the Pacific apparently began in Japan around 1830. Extensive fishing, however, did not begin until some 40 years later. Since then the growth of the industry in the Western Pacific has been erratic. Discovery of new beds has resulted in rapid growth of the industry, only to be followed by equally rapid decline when those beds have been depleted. The discovery of rich coral beds on Milwaukee Banks, 500 miles north-west of Midway Island, led to a boom in the industry in the mid 1960s. Also in the 1960s pink coral beds were discovered in Hawaii, off Oahu. Harvesting of these beds has led to the establishment of a substantial precious coral industry in Hawaii. Legislation and selective harvesting methods have ensured that this resource will continue to be available in the future.

Distribution

In the Pacific Ocean *Corallium* species (pink and white corals) occur in commercial quantities in the Hawaiian island chain and throughout the western Pacific around Japan, the Bonin Islands, the Ryukyu Islands, Taiwan, the Philippines, and south to the Halamahera Islands. It is also known to occur in non-commercial quantities around the Solomon Islands, Western Samoa, and American Samoa in the South Pacific. It is found growing on rocky sea floor where there is no sediment deposition and bottom currents are strong, between 100 m and 400 m water depth.

Gold coral has only recently been used for jewellery. This development has taken place in Hawaii. The corals are found in the same environment as *Corallium*, and as well as off Hawaii they are found in large quantities off Alaska.

Bamboo coral is another deeper-water coral with good potential as a jewel coral. Its use is currently being evaluated in Hawaii.

The shallower-water black coral occurs throughout the Pacific. Small industries producing locally collected and manufactured black coral jewellery have been established in most South Pacific countries. Few of these are using the deeper-water (150-200 feet) species, which is the best quality and therefore most valuable black coral.

Sampling and Harvesting Methods

The deeper-water species are obtained either by dredging or by submersible. Dredging involves dragging over the bottom a river or beach boulder with lengths of old netting or rope attached. The boulder breaks the coral off the bottom, and the nets or teased rope trailing behind pick up the pieces. This method has been used by the Japanese for more than 100 years, and is still in use today. Tests have shown it to be the most efficient type of dredge, despite much experimental work. Simple one-stone nets and more complicated arrangements of several stones suspended from a horizontal bar are both commonly used.

Submersibles are used to harvest coral commercially in Hawaii and Taiwan. This method allows proper management of coral beds, and ensures long-term production. Where the dredging method has been used, beds have been stripped clean. However, properly controlled, dredging is a useful method for exploration.

Black coral is collected by free diving by both breath-hold and scuba divers. However, since the best coral occurs between 150 and 200 feet, scuba diving and its associated risks at these depths are necessary.

Potential in the South Pacific

Corallium is known to occur around three countries (Solomon Islands, Western Samoa, American Samoa) in the South Pacific. However, very little exploration for *Corallium* has been done. From a study of bathymetry a preliminary search for likely sites for *Corallium* has been carried out in Western Samoa, Tonga, and the Cook Islands. Many potential sites occur along the Tonga Platform between Tongatapu and Vavau. In Western Samoa potential sites were identified off the north-west and south-east ends of the island chain. A few potential sites have been identified in the Cook Islands, but lack of bathymetric data makes site identification difficult in this region.

Black coral has been found in many areas, where artisans have already established small businesses making simple jewellery for sale mainly to tourists. This industry will grow as these artisans acquire greater expertise and produce a better-quality end product.

Appendix

CONCLUSIONS FROM THE WORKSHOP ON PRECIOUS CORALS HELD IN NUKU'ALOFA, TONGA

The precious coral industry in the Pacific is of great economic significance, with annual retail sales over US\$400,000,000. Development of a local industry in South Pacific Island countries therefore presents an opportunity that is of great importance and appropriate for development. The precious coral industry in Hawaii has grown eight-fold in the past seven years, which demonstrates the potential in other South Pacific areas. This is especially important since black coral is reported to occur around Tonga, Fiji, Samoa, Papua New Guinea, and other South Pacific countries. In addition, the likelihood that deep-water precious corals (pink, gold, and bamboo) exist in the region is good.

The Sixth Session of CCOP/SOPAC in Port Moresby, Papua New Guinea, during October 1977 decided to convene a workshop on precious corals led by a recognised expert in this field.

This workshop was held in Tonga on 17-19 April, sponsored by CCOP/SOPAC and the Government of the Kingdom of Tonga.

1. The workshop recognised that the state of knowledge, habitat, harvesting techniques, and management methods are different for deep-water precious corals than for shallow-water black corals. They therefore require different approaches to resource development.
2. With respect to the deep-water precious corals the recommendations of the workshop are as follows.
 - (a) An exploratory programme be organised utilising echo-sounding surveys and bottom tangle-nets to establish the presence of deep-water precious coral in the South Pacific.
 - (b) Once the existence of this resource is established, an evaluation programme be organised, possibly utilising a deep submersible (submarine), to delineate the extent and value of the precious coral.
 - (c) A development programme be organised to co-ordinate the orderly exploitation of deep-water precious corals to the greatest advantage of the South Pacific people, including
 - (i) recovery of the precious coral;
 - (ii) training of local artisans to manufacture jewellery from the raw materials;
 - (iii) investigation and development of appropriate markets to merchandise the products.
3. With respect to the shallow-water black corals, which are virtually ubiquitous in the South Pacific, recommendations of the workshop are as follows.

- (a) Resource surveys should be conducted at depths of 20-50 m in areas where strong currents are found and along steep reef drop-offs.
- (b) Once the abundance of the resources has been established, a programme to train local divers in the use of SCUBA should be established. This should be accompanied by the installation of decompression chambers at local hospitals.
- (c) A training programme for local artisans to manufacture jewellery should also be established. This could be in co-operation with the coral jewellery industry in countries such as the United States, Italy, or Japan, such that local artisans could be sent to these countries to develop skills in cutting, polishing, and mounting coral jewellery.
- (d) A marketing programme for black coral could be conducted simultaneously with

marketing studies of deep-water precious corals (pink, gold, and bamboo).

4. Development of the resource should include a management programme. Such a programme should lead to legislation controlling permits, fishing rights, and other appropriate legal controls, which will ensure proper conservation of the resource. In areas where conservation has not been practised precious corals have been rapidly depleted, illustrating the need for proper conservation and enforcement.

Note: A document was presented on the co-operative study of the Kuroshio and adjacent region of the western Pacific, including an outline of scientific programmes and proposed terms of reference for WESTPAC (NR/CCOP/SOPAC (7)/CR.35) (see paragraphs 39-41, Seventh Session TAG Report).

D. Data management

4. REPORT OF ACTIVITIES OF CCOP/SOPAC CONSULTANT GEOLOGIST FOR THE PERIOD 6/2/78 - 8/5/78

(Document NR/CCOP/SOPAC (7)/CR.15)

H. Wittekindt

In 1977 Mr R. Richmond, acting Chairman of the Southwest Quadrant Panel of the Circum-Pacific Map Project, requested through CCOP/SOPAC assistance from the Government of the Federal Republic of Germany to compile data for the Project. As a result of this request I spent three months in Suva, Fiji, during February-May 1978. My duties were to compile the available data in order to produce three maps of the Southwest Pacific Region on behalf of the Circum-Pacific Map Project:

- (i) a geological map, scale 1:10,000,000;
- (ii) a tectonic map, scale 1:10,000,000;
- (iii) a mineral map, scale 1:10,000,000.

The area concerned was the eastern part of the Southwest Quadrant map, which includes the following countries and islands:

Papua New Guinea, Caroline Islands, Marshall Islands, Gilbert Islands, Tuvalu, Nauru, Phoenix Islands, Niue Island, Solomon Islands, New Caledonia, Loyalty Islands, New Hebrides, Fiji, Kingdom of Tonga, New Zealand, and parts of the Line Islands and Cook Islands.

The aim was to make an initial compilation of maps within the framework chosen for the Circum-

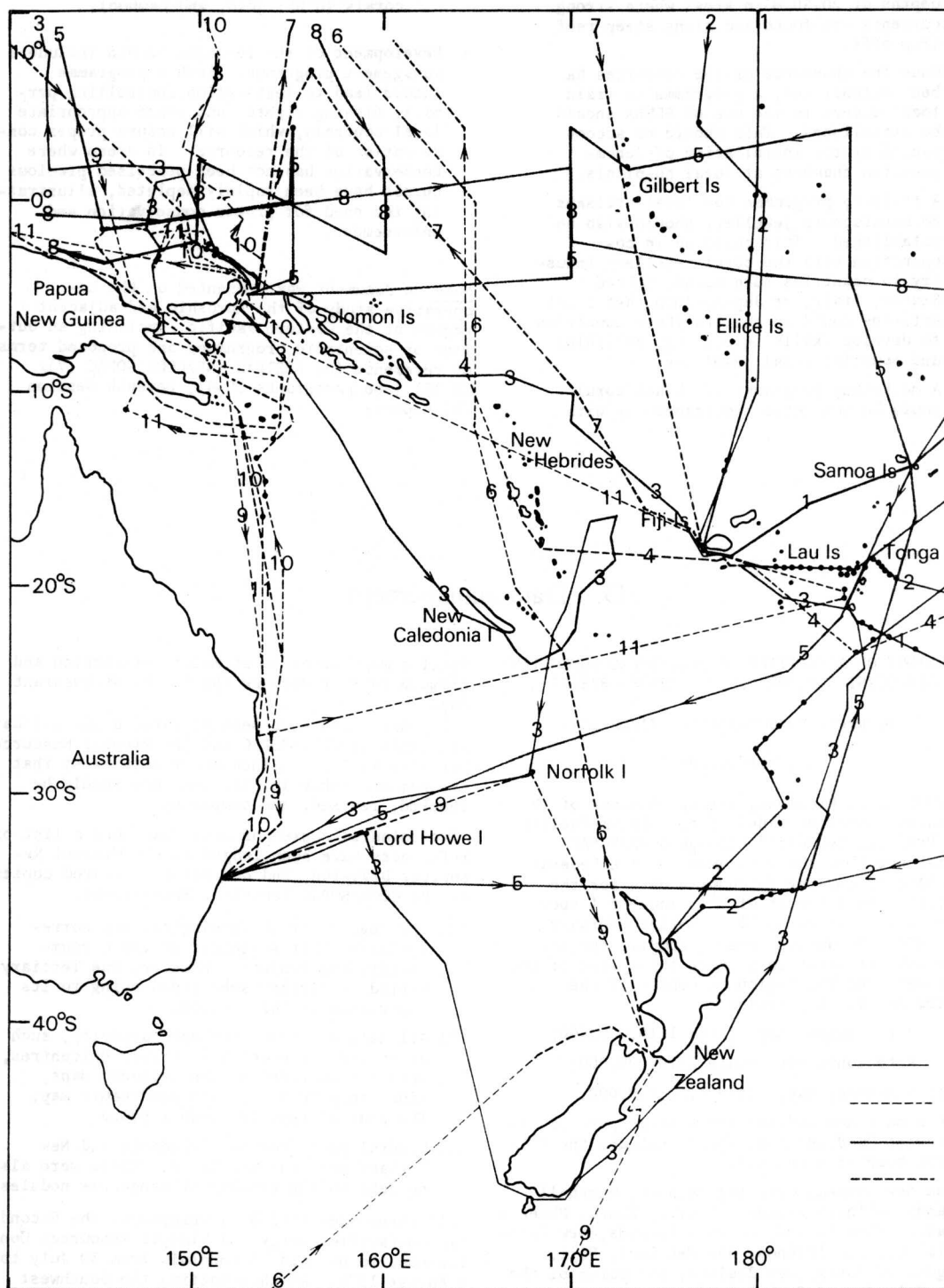
Pacific Map Series to stimulate discussion and promote further work on the Southwest Quadrant maps.

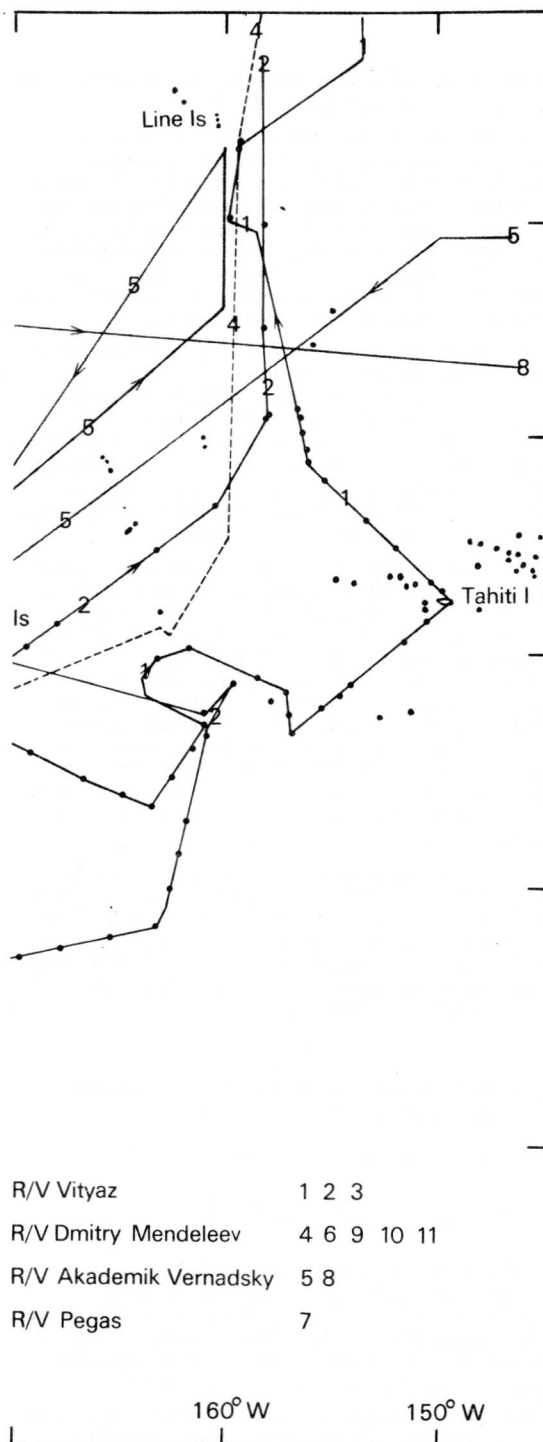
The three maps have been prepared using all data available at CCOP/SOPAC and the Mineral Resources Division in Suva. Since other data exist that are not available in Fiji the maps should be checked, revised, and completed.

Two coloured copies of each chart and a list of references have been lodged at the Mineral Resources Division, and one set of coloured copies at the CCOP/SOPAC Technical Secretariat.

- (a) The legend for the geological map corresponds to that suggested by the Circum-Pacific Map Project. However, the Tertiary Period is further subdivided owing to its importance in this region.
- (b) All data on recent tectonic activity, such as active volcanoes and seismic epicentres, were not included on the tectonic maps, since they belong to the geodynamic map. The crustal type is shown instead.
- (c) Mineral data from New Caledonia and New Zealand were not available. There were also no data on the density of manganese nodules.

All three maps will be displayed at the Second Circum-Pacific Energy and Mineral Resources Conference, to be held in Honolulu from 30 July to 4 August 1978. At this meeting the Southwest Quadrant Panel should decide what further action is needed to complete the maps, and establish a programme to do this.





5. SOVIET GEOLOGICAL-GEOPHYSICAL INVESTIGATION IN THE SW PACIFIC (MAP)

(Document NR/CCOP/SOPAC (7)/CR.32)

Submitted by the USSR Delegation

LEGEND

1. R/V Vityaz, cruise 43, 1968.
Institute of Oceanology, USSR Academy of Sciences.
2. R/V Vityaz, cruise 48, 1970.
Institute of Oceanology, USSR Academy of Sciences.
3. R/V Vityaz, cruise 49, 1970-71.
Institute of Oceanology, USSR Academy of Sciences.
4. R/V Dmitry Mendeleev, cruise 5, 1971.
Institute of Oceanology, USSR Academy of Sciences.
5. R/V Akademik Vernadsky, cruise 4, 1971.
Marine Hydrophysical Institute, Ukrainian Academy of Sciences.
6. R/V Dmitry Mendeleev, cruise 11, 1973-74.
Institute of Oceanology, USSR Academy of Sciences.
7. R/V Pegas, cruise 7, 1975-76.
Sakhalin Complex Institute, Far Eastern Scientific Center of USSR Academy of Sciences.
8. R/V Akademik Vernadsky, cruise 12, 1975-76.
Marine Hydrophysical Institute, Ukrainian Academy of Sciences.
9. R/V Dmitry Mendeleev, cruise 16, 1975-76.
Institute of Oceanology, USSR Academy of Sciences.
10. R/V Dmitry Mendeleev, cruise 17, 1976.
Institute of Oceanology, USSR Academy of Sciences.
11. R/V Dmitry Mendeleev, cruise 18, 1976-77.
Institute of Oceanology, USSR Academy of Sciences.

—•— Significant work at stations.

[Owing to limitations of scale, cruise track detail cannot be adequately rendered in some areas, particularly around Papua New Guinea and the Solomon Islands.]

E. Training and other assistance

6. REPORT ON THE REGIONAL TRAINING COURSES IN BASIC EARTH SCIENCE

(Document NR/CCOP/SOPAC (7)/CR.14)

R.J. Morrison
University of the South Pacific

A Regional Training Course in Basic Earth Science was organised by the University of the South Pacific's Institute of Natural Resources, as a consequence of a recommendation of the Fourth Session of CCOP/SOPAC. The course was funded by UNESCO/IOC and the Australian Government. This training course in geology, geochemistry, and geophysics was aimed at meeting the needs of the South Pacific region for junior staff to help in geological surveying, which will enable the countries of the region to exploit fully their mineral resources, both on land and offshore.

The course ran from 1 November 1977 to 24 February 1978, with a total of 17 teaching weeks. Originally 18 participants were nominated, but one was unable to attend for personal reasons. The 17 participants, with nominating authorities, are listed below.

Participant	Nominating Authority
Mr Siniala AVENGA	Tuvalu Govt.
Mr Nofaga KAPOA	Emperor Gold Mining Co.
Mr Sitivi KAMU	Western Samoa Govt.
Mr Talanoafuka KITEKEI	AHO Tonga Govt.
Mr Mose LATA	Western Samoa Govt.
Mr Samuela LOKI	Fiji Govt.
Mr Rennel MAGU	Solomon Islands Govt.
Mr Sekove MOTUIWACA	Amax Exploration Co.
Mr Mawendra NANDAN	Fiji Govt.
Mr Ermas NGIRAELEBAED	TTPI Govt.
Mr Vahu ORU	Papua New Guinea Govt.
Mr Teariki RONGO	Cook Islands Govt.
Mr Sione SOAKAI	Tonga Govt.
Mr Alexander TARI	New Hebrides Govt.
Mr Tevita VUIBAU	Fiji Govt.
Mr Balthasar WAYI	Papua New Guinea Govt.
Mr Frank WHIPPY	Fiji Govt.

The Course Director, Dr C.D. Ollier of the Research School of Pacific Studies, Australian National University, Canberra, was assisted by the following teaching staff:

Dr R.J. Morrison)	
Mr J. Bonato)	School of Natural Resources,
Mr S. Muralidhar)	University of the South
Mr R. McKenzie)	Pacific
Mr J. Halunen)	From CCOP/SOPAC Technical
Mr J. Eade)	Secretariat
Mr P. Rodda	Mineral Resources Division,
	Fiji
Dr M. Leggo	Amax Exploration Co. Ltd

A technical assistant was also employed for the duration of the course.

The activities included in the course were lectures, practical demonstrations, assigned practical work, field trips (usually followed by laboratory work on samples), seminars, and discussion groups. The field trips were mainly on Viti Levu, but also included a four-day expedition to Ovalau, to give the participants an opportunity to experience some of the techniques involved in marine geological surveys.

The course attempted to cover as much elementary geology as possible, but time and the limited background of some of the participants caused some restrictions. The general topics covered in the course were weathering, tectonics, coasts and rivers, earth structure, hydrology, coral islands, sand dunes, geological process rates, stratigraphy, volcanoes, economic geology, petrology, soils, and marine geology.

Participants were shown how to interpret geological maps, diagrams, and aerial photographs; identify hand specimens of rocks and minerals (including those of economic importance); use binocular, plain light, and petrological microscopes; identify fossils; interpret seismograph readings; use an echo-sounder to study the shape of the ocean floor; determine bearings, elevations, altitudes, etc.; carry out routine laboratory tests associated with the above activities; and carry out calculations on the various topics and activities, where appropriate.

The participants were assessed continuously by spot tests, written assignments, and performance in practical exercises. At the end of the course a series of examinations (one theory and three practical) was held. All the participants received certificates indicating that they had completed the course.

7. REPORT ON TRAINING PROGRAMME IN OFFSHORE MINERAL PROSPECTING TECHNIQUES

(From Document NR/CCOP/SOPAC (7)/CR.9)

Eroni J. Tupua
Mineral Resources Department, Suva, Fiji

At the Sixth Session of CCOP/SOPAC, in Port Moresby, the Japanese Government invited a trainee from Fiji on board their research vessel R/V *Hakurei Maru* on its first scheduled cruise of the 1978 programme (GH78-1) from Japan to Suva through the Central Pacific Basin.

The Intergovernmental Oceanographic Commission (IOC) provided the air fare, hotel expenses, and the expenses while on the ship from Japan to Suva.

The main purpose of the survey was to study the distribution, properties, and genesis of deep-sea mineral resources (manganese nodules) and to study the basic problems related to techniques for exploitation of mineral resources.

The survey area was east of the Marshall Islands (7°-13°N, 177°-180°E) and west of the Central Pacific Basin. Two samples were also taken at 1° intervals, to compare results, (13°N, 179°W and 12°N, 179°W).

Training was carried out under the supervision of Dr Moritani, and included working with and learning about the following shipboard activities: navigation (NNSS); submarine topography (echo-sounding); submarine geological structure - 3.5 kHz sub-bottom profiler and air-gun system; gravity measurement - on-board gravity meter; magnetism measurement - on-board magnetometer; sampling of sediments and manganese nodules; observation of sea bottom - deep-sea camera, free-fall camera; measurements of physical and chemical properties - STD, vane strength.

Note: Document NR/CCOP/SOPAC (7)/CR.19 regarding future training courses in basic earth sciences is summarised in paragraph 52, Seventh Session TAG Report. Document NR/CCOP/SOPAC (7)/CR.10, which details assistance required by Fiji from the Technical Secretariat, is taken from the work programme.

F. Technology of offshore exploration and mining

8. DEVELOPMENTS ON MANGANESE NODULES/CRUSTS

(Document NR/CCOP/SOPAC (7)/4)

CCOP/SOPAC Technical Secretariat

Four consortia of multinational companies have to date expended \$150 million or more on testing and exploration for manganese nodules/crusts. It is estimated that at least several billion dollars more will be spent to begin commercial production. Some companies believe this will take place in the late 1980s or early 1990s, and this has created an atmosphere of pessimism in the face of world-wide overproduction from conventional mining of nickel and copper. Additionally, lack of an international treaty casts uncertainties over the foreseeable future of manganese nodules/crusts.

Some noteworthy items have come to the attention of the Technical Secretariat.

1. Tests using the CLB (continuous line bucket) method in >5000 m depths recovered a few tonnes of nodules. Although the method has a poor past performance, there is continued development in the belief that, should it be perfected, it will be cheaper and easier to construct and operate than the hydraulic and/or airlift systems at present favoured by some consortia.
2. The hydraulic and/or airlift system was successfully operated earlier this year by the Ocean Management Inc. (OMI) consortium company some 1600 km south-east of Hawaii, bringing up at least 850 tonnes of nodules.
3. The OMI tests and operations were closely observed and monitored for three months by the U.S. National Oceanic and Atmospheric Administration. Their conclusion was that there were no demonstrable negative environmental effects from the nodule recovery operations, but that long-term effects are still unknown.

4. The *Glomar Explorer* has been leased for at least 13 months by Global Marine Development Company, who will modify the ship for nodule retrieval from 4,600 to 5,500 m for the consortium - Ocean Minerals Co.

5. The State of Hawaii is addressing the feasibility of a manganese nodule processing plant from the standpoint of potential economic, environmental, and social impacts. Processing requires significant amounts of energy, principally electrical. In this regard a geothermal steam well has been completed on the island of Hawaii which will be put on stream through a test turbine electrical generator in the near future. Selection of Hawaii as a site for manganese nodule processing is heavily dependent on adequate electrical energy.

9. OCEAN THERMAL ENERGY CONVERSION (OTEC)

(Document NR/CCOP/SOPAC (7)/5)

CCOP/SOPAC Technical Secretariat

OTEC is a concept of using the temperature difference (33-40°F) between warm ocean surface water and cold deeper water to release stored solar energy; this powers a turbine to produce electricity. The concept has been demonstrated on a small scale, but OTEC is still a research and development project. Whether it will be feasible for large-scale systems depends on technology not yet developed, and whose problems are not minor. The value of OTEC depends heavily on the future price of competitive and alternative energy sources, which could become critical to the world in the coming years. Alternative uses of OTEC might be production of ammonia for industrial and/or fertiliser use and power production for electricity-intensive industries (e.g., bauxite or manganese nodule processing).

Stated simply, heat from warm surface waters can evaporate certain fluids (e.g., ammonia); the resulting vapour is passed through a turbine and then condensed by chilling it with cold water from the deeper part of the ocean. Important criteria for site selection are (1) high temperature differences between surface water and deeper, colder water; (2) low current velocities; (3) minimal wind and waves; and (4) nearness to electricity consumer. Best potential sites are located between 20°N and S of the Equator and where warm currents move away from the Equator; this would include most of the area of CCOP/SOPAC countries.

The Technical Secretariat was recently informed that the Kona coast of the Island of Hawaii has been selected for the first significant-scale tests of OTEC, to be conducted by a consortium of high-technology companies.

10. NITROGEN FERTILIZER GENERATOR FOR SMALL FARMS OR LOCALIZED FARM AREAS

(Document NR/CCOP/SOPAC (7)/2)

CCOP/SOPAC Technical Secretariat

The Charles F. Kettering Research Laboratory is developing a prototype system to generate nitrogen fertilizer in the form of nitrates for small farm use. The system shows promise in being both technically and economically feasible for certain farming conditions. It may be powered by a conventional electrical utility source or, preferably, by conversion from waterfall, wind, or solar energy into electrical energy. The method used produces nitrogen fertilizer from the air by combining nitrogen and oxygen in an electric arc. The combination is a gas which is readily trapped in water; to this is added lime (CaO) or limestone (CaCO₃), a rock that is commonly available, to end up with principally a calcium nitrate fertilizer. If, instead of limestone, phosphate rock - which is less abundant than limestone but still relatively common - is added, nitrate and phosphate fertilizer is generated. In one working system it is proposed that the fertilizer would be stored in water solution for spraying on fields or fed into irrigation water as needed. This new process could be used advantageously in the trade wind belt of the Pacific Islands. Constraints are: wet paddy or low pH soils, which inefficiently use nitrogen fertilizers; cost may be too high for small farmers in developing countries; storage of fertilizer elements; resistance to innovation; and aversion to use of sophisticated systems. The East-West Resources Systems Institute of the East-West Center, 1777 East-West Road, Honolulu, Hawaii 96848, solicits inquiries and information leading to ongoing research and development of nitrogen fertilizer generators.

11. PHOSPHORITE PROSPECTING USING A SUBMERSIBLE SCINTILLATION COUNTER

(Document NR/CCOP/SOPAC (7)/3)

CCOP/SOPAC Technical Secretariat

Rapid detection of submarine phosphates by geophysical means would be a desirable development for exploration in South-west Pacific areas. Sedimentary marine phosphorites generally have a detectable level of radioactivity formed by the uptake of uranium from sea water during their genesis. Marine phosphorites generally have a much higher level of radioactivity than guano-phosphates. However, if guano-derived phosphates have been submerged for some time they apparently 'soak up' sufficient uranium from sea water to enhance their radioactivity.

Although controversial, the general view is that uranium substitutes for calcium in apatite (phosphorus-bearing mineral), and can produce anomalously high radioactivity, which can be detected. Considerable developmental work on a submersible scintillation counter has been done by Geoff Symons at Harwell (UK). The 'Symons System' has been used to detect sedimentary marine phosphorite, but is much too large to use in lagoonal or shallow guyot environments or on the small vessels from which CCOP/SOPAC does its work. It has been suggested by Peter Cook, Senior Research Fellow in Economic Geology at the Australian National University Research School of Earth Sciences, that it may be feasible to waterproof a scintillometer on a short cable for work in lagoons or shallow water. This might quickly detect the distribution of sedimentary or guano-derived phosphates, provided the phosphates are not buried too deeply by non-phosphatic sediments. CCOP/SOPAC is pursuing this aspect further.

12. SEA TRIALS AND DEMONSTRATION OF THE FIJI MINERAL RESOURCES DIVISION (OFFSHORE) MX1102 SATNAV ON USSC's M/V MARAMA, 6-20 JUNE 1978 : OSCAR AROUND THE ISLANDS

(Abstracted from

Document NR/CCOP/SOPAC (7)/CR.7)

R.T.R. Wingfield

Mineral Resources Department, Fiji

(with appendices by Capt. J.A.F. Jenkins, Master, M/V Marama, Union Steam Ship Co. (N.Z.) Ltd, and T.K. Vuibau, Mineral Resources Department, Fiji)

It was shown that the MX1102 performed to specifications, and that a single-channel SATNAV is the most desirable for survey and marine transport work in the South Pacific. As claimed, the accuracy was about 100 m for a single fix; a slight spread of longitudinal values, resulting from uncertainty in the reference geoid in this area, could be corrected with the 'twin-pass' method. The charted position of several points was shown to be in error.

G. Status of activities relating to the work programme

13. GEOLOGICAL SURVEY OF PAPUA NEW GUINEA : SUMMARY OF ACTIVITY SEPTEMBER 1977 TO SEPTEMBER 1978

(Document NR/CCOP/SOPAC (7)/CR.27)

Geological Survey of Papua New Guinea

The Economic and Regional Geology Section completed field work in connection with the Minj 1:100,000 sheet; compilation of data and the preparation of explanatory notes are under way. Field work was completed for the Murua 1:250,000 sheet (includes Woodlark Island); the final report is near completion. A reconnaissance helicopter survey was carried out over the Wau 1:100,000 sheet area - a preliminary exercise to a proposed full-scale mapping programme in 1979. The Ok Tedi 1:100,000 Geology sheet and explanatory notes are close to completion. An in-depth re-appraisal and re-evaluation of the Wau Goldfield was carried out - the results will be published as a volume of the GSPNG Memoir Series. As part of the National Public Expenditure Plan, detailed proposals for the establishment of a Petroleum Resources Assessment Group and a post for an Industrial Minerals Geologist were prepared and submitted to the National Planning Office.

The Engineering and Environmental Geology and Hydrogeology Section, acting as consultant to other Government departments and statutory bodies, completed several engineering site investigations and construction materials studies. Significant projects completed were preliminary site investigations for proposed major hydro-power projects in the Star Mountains (in connection with the Ok Tedi Project) and on the Kaugel River in the northern part of the Southern Highlands Province; other site investigations for proposed major hydro-power projects (Upper Warangai Project, Gazelle Peninsula, and Rouna No. 4 near Port Moresby) are continuing. Groundwater exploration, evaluation, and development continued at a high level, ranging from major urban water supply supplement projects, which are continuing, to village, plantation, and even school water supply projects.

The Geophysical Services Section, as well as undertaking mainly resistivity and seismic surveys in connection with engineering site investigations and groundwater exploration and evaluation projects, carried out a regional gravity survey in central northern Papua (discussed in Project Status Sheet for CCSP-1/PN.4 - Agenda Item 3a). An important innovation was the investigation of the geothermal field near Talasea in West New Britain. Field work was completed, and interpretation of resistivity and temperature data is in progress.

The Geophysical Observatory Section, located in Port Moresby and formerly operated by the Australian Bureau of Mineral Resources, Geology, and

Geophysics, was taken under the umbrella of the GSPNG. Formal transfer was finalised near the end of the period. The section maintains a network of seismograph and accelerograph stations throughout PNG.

The Volcanological Observatory Section continued to maintain and augment the volcano surveillance and monitoring network throughout PNG. Mount Ulawan, New Britain Island, erupted during the period, and at the time of writing the volcano on Kar Kar Island, off the northern coast of the PNG mainland, was showing increased activity; an eruption has been forecast.

14. REVIEW OF SURVEY ACTIVITIES - PROGRESS, RESULTS, AND INTENTIONS

(Abstracted from
Document NR/CCOP/SOPAC (7)/CR.12)

R.T.R. Wingfield
Mineral Resources Department, Fiji

Mineral Resources Department personnel have to date undertaken three cruises in 1978.

Mr Tupua's cruise with the Japanese Geological Survey was arranged through CCOP/SOPAC with funding by IOC.

The month-long sea trials and demonstration of SATNAV aboard M/V *Marama* resulted from liaison between MRD(O), USSC, and CCOP/SOPAC, particularly with Capt. Jenkins of USSC, who served in 1977 as foreign-going master of M/V *Acheron* during her charter to CCOP/SOPAC.

The MRD(O) 20 metre vessel described in NR/CCOP/SOPAC (6)/CR(FJ) 32(6-32) was launched, as R/V *Bulikula*, a month after the Sixth Session in November 1977. Outfitting is near completion, and almost all equipment and instrumentation itemised in that paper is aboard.

Shipyard acceptance trials commenced in mid September 1978, and crew applications are currently under review. Work-up trials are scheduled to commence mid November 1978, leading to initiation of the programme of a decade of shallow marine reconnaissance geological and geophysical surveys, described in 6-32/B.7 within the first months of 1979.

Charters by an oil company in Fiji and for offshore engineering studies are already discussed for inclusion early in 1979. These charters should include inputs by the companies concerned of offshore technical personnel and further instrumentation.

Plans are furthermore in hand for sea temperature and biological studies with University of the South Pacific scientists; for hydrographic and geodetic studies with RFN/Hydrographic Section; and for regular meteorological data collecting for Nadi Meteorological Office. IOC

have offered to supply X.B.T. gear so that R/V Bulikula can contribute to their world-wide marine temperature studies.

Present planning aims to place R/V Bulikula under Fiji-based long-term management in 1979. Recruitment at present going forward is aimed at obtaining a master for the vessel with experience of marine surveys and academic qualification in marine geology.

15. SURVEY ACTIVITIES IN THE SOLOMON ISLANDS

(Document NR/CCOP/SOPAC (7)/CR.17)

Solomon Islands Delegation

A. Activities within the CCOP/SOPAC Work Programme

CCSP-1/SI.9. Investigation into the sediments of the Indispensable Reefs lagoon and Lake Te Ngano, eastern Rennell: the survey was carried out in May 1977.

A preliminary report on the results of a survey for possible bauxite deposits was presented at the Sixth Session in Port Moresby. Work has continued throughout the year on finalisation of the report, pending availability of analytical results.

Visits. CCOP/SOPAC marine geologists visited the Solomon Islands for consultations and preliminary planning in October 1977, March 1978, and August 1978. The UNDP Technical Review Mission visited Honiara in June.

Training. One Solomon Islander attended the basic earth science course at the University of the South Pacific, Suva, in the latter part of 1977. Some practical training was given, aboard a marine research vessel, on echo-sounding, bottom-sampling, etc.

B. Other Activities

All other survey activities in the Solomon Islands during the past year have been based on land.

1. The Western Solomons Mapping Project

Field work on the island of Choiseul, by the seven-man U.K. Technical Co-operation Team, has been completed in 1978. A memoir and a complete set of maps to the scale of 1:50,000 remain to be drafted.

A successor project to map the New Georgia Group has been approved to start in 1979.

This emphasis on the Western Solomons means that a very comprehensive geological statement on the land areas should be available by the end of 1981. A bathymetric project covering the adjacent seas over the same period would be most appropriately timed.

2. Seismic Surveillance

The Seismological Section of the Ministry of Natural Resources operates the Honiara station

of the World-Wide Standard Seismograph Network. Plans are under way to instal a Sprengnether teleseismic link to Savo Volcano, 24 miles from Honiara. The Seismological Observer is to travel to the Global Seismology Unit, Edinburgh, in late 1978 for five months' appropriate technical familiarisation.

3. Hydrology

It is hoped to recruit a Water Resources Officer in the near future, to help with training and with organisation of the installation and maintenance of a national hydrometric network, also to consult on hydrogeological problems. In 1978 work on the design stage has been completed for the important Lungga hydroelectric scheme six miles from the capital, Honiara.

4. Geothermal Resources

New Zealand Aid for geothermal exploration on Vella Lavella island in the Western Solomons was discontinued in 1978. The Paraso field, which has an estimated power availability of 10 megawatts, requires further investigation, primarily a resistivity survey followed by a drilling programme. Aid sources for exploration are being sought.

5. Mining and Prospecting Activities

Prospecting licences are currently held by RMG Services Pty Ltd (primarily prospecting for chromite and other heavy minerals on San Jorge), and by Essex Minerals (searching for copper and other metals in massive sulphide prospects in the Florida Islands). Western Mining Corporation Ltd have applied for a reconnaissance permit covering a copper prospect in eastern New Georgia.

Mining of the bauxite deposits on Rennell and Vaghena Islands, by Mitsui Mining and Smelting Co. Ltd and Pacific Aluminium Pty Ltd respectively, has been held up by failure to find a market for alumina and uncertainties over the appropriate technology. A market study is being pursued this year.

16. SUMMARY OF THE ORSTOM/USA JOINT RESEARCH PROGRAMME : DYNAMICS OF THE SOUTH-WEST PACIFIC

(Document NR/CCOP/SOPAC (7)/CR.33)

G.V. Latham
Marine Science Institute,
University of Texas, USA

1. ORSTOM/University of Texas

Beginning in 1976, a series of seismic experiments has been conducted in the region of the New Hebrides as part of a co-operative programme between ORSTOM and the Marine Science Institute of the University of Texas (UT/MSI).

The objectives of this programme are to determine the dynamics and structure of the New Hebrides Island Ridge and its active marginal zones. UT/MSI has provided personnel and Texas ocean bottom seismic stations for use in the programme; ORSTOM has provided scientific and supporting staff, ship time, and underway geophysical measurements.

In the initial field programme (summer 1976) a series of short refraction profiles, using a small air-gun source, was obtained in the central New Hebrides. In 1977 additional refraction profiles were obtained using air-gun and explosive sources, and a network of eight ocean-bottom seismic stations was installed in the south central New Hebrides to monitor local earthquakes. Approximately 500 earthquakes were recorded by the stations of this network in 35 days of operation. A short experiment in the back arc basin, east of Tanna (Coriolis Trough), showed this zone to be extremely active. Approximately 150 earthquakes were recorded in a one-day period, with depths ranging between 10 and 25 km. Processing and analysis of data and publication of results from this work are being carried out jointly by scientists of ORSTOM, UT/MSI, and Cornell University.

The programme planned for 1978 includes additional refraction lines in the New Hebrides, New Caledonia, Fiji Plateau, and Tonga Islands, using a larger air-gun (16 litres) and explosive sources, and installation of an eight-station network of OBS stations in the central New Hebrides to monitor earthquakes for a period of six weeks.

2. ORSTOM/Cornell/USGS

In 1978 the programme of tilt and seismic measurements in the central New Hebrides took a major step forward with the installation of a ten-station radio-telemetering seismic network. Data are received at the ORSTOM headquarters in Port Vila, Efate, and are recorded by a memory-triggering system. This permits high-speed recording and, thus, much greater time resolution than is possible with the continuous drum recorders used previously. The stations of the ocean bottom seismic network will be located so as to complement the island network.

3. ORSTOM/NOAA

An aeromagnetic survey of the Fiji Plateau was completed by Dr Alexander Malahoff, of NOAA, in 1977. The results of this survey have been provided to the planning group of DSP (Dynamics of the Southwest Pacific) as a guide to the proper location of future refraction profiles and earthquake networks on the Fiji Plateau. In addition, NOAA has provided a La Coste gravimeter to permit acquisition of gravity data aboard R/V *Coriolis* throughout the 1978 campaign.

Note: A preliminary report on ORSTOM cruise EVA III in the Kingdom of Tonga was presented (Document NR/CCOP/SOPAC (7)/CR.29).

Progress on member countries' projects was presented in documents NR/CCOP/SOPAC (7)/CR.2, CR.8, CR.46, and CR.47. Revisions and additions to member countries' projects were presented in documents NR/CCOP/SOPAC (7)/CR.37 and CR.40-45. For details see Annex II, Work Programme.

H. Hydrocarbons in the South Pacific

17. THEORETICAL PREREQUISITES OF OIL-GAS FIELDS IN DEEP-SEA DEPRESSIONS OF THE PACIFIC OCEAN MARGINAL SEAS

(Abstracted from
Document NR/CCOP/SOPAC (7)/CR.34)

L.E. Levin
Ministry of Geology of the USSR

The integrated study of the information available on the geology and oil-gas potential of the Pacific mobile belt and the Pacific Ocean carried out by the Soviet scientists, and the construction of "The Map of Oil and Coal Promising Areas in the Pacific Mobile Belt and the Pacific Ocean", scale 1:10,000,000, made it possible to distinguish eight genetic types of the sedimentary basins confined to the above described belts as well as those lying outside (N.A. Eremenko, L.E. Levin). They are (i) oceanic basins; (ii) basins in the recent active oceanic margins; (iii) basins in the zones transitional between the ancient and recent oceanic margins; (iv) basins in ancient passive margins; (v) basins in the orogenic

depressions confined to the continental and subcontinental crust; (vi) basins in the depressed areas of the platform orogenesis; (vii) basins in the intraplatform synclines; and (viii) basins in the recent passive oceanic margins. This classification of the sedimentary basins according to their genesis incorporates both the modern concept of mobilism and the principles of the classical tectonics. The deep depressions in the marginal and inland seas of the western part of the Pacific Ocean floor structurally disturb the basins belonging to three genetic types, such as (i) associated with the recent active margins in the Philippines, Banda, New Guinea, and Fiji Seas; (ii) associated with the areas transitional from old to recent active margins in the Bering, Okhotsk, Japan, East China, South China, and Coral Seas; and (iii) associated with recent passive margins mainly in the Tasman Sea.

In the Pacific deep-sea depressions, whose promises for revealing common types of gas and oil accumulations should be negatively evaluated, detection of deposits of hydrated gases is not excluded, as it was assumed by several

authors (D.I. Milton, A.A. Trofimuk). The most interesting objects for the search of hydrated gas deposits are sedimentary basins in the west of the Pacific-Kula, Ontong-Djawa, Pre-New Zealand, with sedimentary strata from the Jurassic or Cretaceous to the Pleistocene inclusively. In sections of several of these basins (the Magellan uplift, Manihiki plateau, Ontong-Djawa plateau), along with deep-sea deposits, deposits of shallow marine genesis have been revealed, and this fact shows favourable premises for the formation of cap rocks.

Towards volcanic islands, that complicate the structure of the basins, the probability of the formation of hydrated gas deposits reduces in connection with the heat flow increase.

18. DEVELOPMENTS IN NEW ZEALAND AND SOUTH-WEST PACIFIC ISLAND REGION IN 1977

(Abstracted from
Document NR/CCOP/SOPAC (7)/CR.22)

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New Zealand Geological Survey, DSIR,
New Zealand

In New Zealand, two further offshore wells were drilled in the Great South Basin, both in water nearly 700 m deep; both were abandoned, but one of them (Kawau-1A) had shows and tested gas and condensate. On land, the newly established Government company drilled one well (testing saltwater) and part of a second near the Kotuku oil seepage in Westland, South Island. Both on land and offshore total depth drilled was 9450 m, down 46%. Production from the Kapuni field was further increased to 2,261,903 m³ of gas (218.8 MMCFGD, up 59.3%) and 860,973 m³ of condensate (14,837 b/d, up 43.4%). Work on the Maui platform and pipeline was virtually completed, and production drilling is scheduled to start early in 1978. Considerable offshore acreage has expired; the total of remaining offshore concessions is 432,302 km² (166,912 sq. miles). On land all but 383 km² (148 sq. miles) have expired, but the Government, in the course of its new policy to actively go into petroleum exploration itself, has acquired six concession blocks on both main islands, totalling 12,118 km² (4,825 sq. miles).

In Tonga a detailed seismic survey of 283 km was conducted on the island of Tongatapu, and 732 km of offshore seismic lines recorded by Shell in 1970 were reprocessed by Webb Tonga Inc. As a result, it is planned to drill three major seismic anomalies which have been interpreted as carbonate reef structures.

In Fiji no further activities are reported, since all licences have expired. As a result all offshore geophysical data are now available on Open File.

In Papua New Guinea one seismic survey, which was begun in July 1976, was completed, and one offshore well was drilled to a depth of 3,433 m;

it was plugged and abandoned. Some concession changes occurred in the Gulf of Papua, while in the Solomon Sea the Government for the first time invited applications for 60 blocks of offshore Petroleum Prospecting Licences. There has been no final solution to the boundary dispute with Australia in Torres Strait.

19. PROGRESS OF PETROLEUM EXPLORATION OFFSHORE NEW ZEALAND

(Document NR/CCOP/SOPAC (7)/CR.20)

H.R. Katz
New Zealand Geological Survey, DSIR,
New Zealand

The large Great South Basin to the south and south-east of the South Island continued to be the only region of exploration activity. Under very difficult weather and sea conditions, and in water depths of nearly 700 m, the Sea Hunt Group drilled three more wells. Only one of these, Kawau-1A, tested some gas and condensate, but was found non-commercial. Kawau-1A took 30 weeks to drill and cost more than \$18 million (of which the New Zealand Government is committed to pay 40%).

The Great South Basin remains a prospective area, however, and will need further evaluation and more drilling. But the Hunt and Phillips Petroleum companies, discouraged mainly by the Government's tax proposals, have decided for the time being not to go any further. Using a sole risk clause laid down in the agreement, the Government then opted to drill two more wells financed entirely by itself. Their locations are in shallow water near the western edge of the basin; both were dry. This initiative by the Government is noteworthy, and is in line with its new policy, adopted in July 1977, of actively entering the exploration field by establishing its own company, 'Petrocorp'; Petrocorp has since become the sole explorer on land.

The semi-submersible Penrod-74 rig is now awaiting decision for being decommissioned and sent away from New Zealand; alternatively, it may be hired by Aquitaine for a test in Tasman Bay near Nelson. Several more drilling targets are available in that region to the north of the South Island and west of the North Island (Taranaki Basin), but except for that one well of Aquitaine no agreements have been reached so far with the Government.

Development of the large Maui gas-condensate field is now going ahead on schedule. Construction and pin-piling of the platform and laying of the sub-sea pipeline were completed by the end of 1977. The drilling of 12 development wells commenced in February 1978, and production is scheduled to begin about April 1979, fully 10 years after the discovery of the field; the cost of this first product-

ion stage (a second platform is planned for later) will have topped \$1,000 million.

Offshore concession areas have decreased considerably during the past year, and are now 432,302 km² (166,912 sq. miles). All seismic and well data from relinquished areas are held on Open File with the New Zealand Geological Survey in Lower Hutt, and are available for review and copying.

20. PETROLEUM EXPLORATION IN TONGA

(Document NR/CCOP/SOPAC (7)/CR.21)

H.R. Katz
New Zealand Geological Survey, DSIR,
New Zealand

The results of a four-month Seismic Survey on the island of Tongatapu (March to June 1977), and reprocessing of earlier marine seismic data obtained from Shell, had indicated the possibility of widespread reef growth during Oligocene-Miocene times. Seismic anomalies suggested fringing and pinnacle reefs along a roughly north-south-oriented belt; if confirmed, such reefs would obviously have a considerable potential. The company (Webb Tonga Inc.) therefore decided to test three of these anomalies on Tongatapu.

The wells - Kumimonu-1, Kumimonu-2, and Kumimonu-3 (their naming and designation do not reflect location on the same structure) - were drilled between February and June 1978. Their total depths were 8352 ft, 6984 ft, and 8635 ft respectively. They were abandoned as dry; none of the wells encountered any reef limestones, but the company felt sufficiently encouraged by the results to propose a marine seismic survey, after which it is hoped to establish a new drilling location offshore.

The total cost of the Webb Tonga exploration programme to date has exceeded US\$7 million. Of this amount, US\$617,200 was pumped directly into Tonga's economy ("The Tonga Chronicle", Vol. XV No. 7 of 14 July 1978) by way of disbursing money into the public and private sectors through the payment of wages to local labour; hotel and other accommodation; food and meals; hire of machinery, cranes, bulldozers, and other vehicles; lease payments; local purchases; electricity and water supply; and numerous other local services. Although no oil has been found at this stage, considerable benefit has accrued to the Kingdom, through local employment and injection of foreign currency, which have contributed substantially to the national economy.

As a whole, within deep-sea depressions in the south-west of the Pacific and its framing under the prevailing of vast spaces with little or negative promises for oil and gas potential, there are still regions where areas for the concentration of considerable hydrocarbon reserves can be found.

21. PROGRESS REPORT ON OIL EXPLORATION ACTIVITY IN FIJI WATERS

(Document NR/CCOP/SOPAC (7)/CR.18)

R.N. Richmond
Mineral Resources Department, Fiji

After very quiet inactive years in 1976 and 1977 oil exploration activity received a sudden impetus with the granting of options over three areas and a licence over one area. Results of initial work this year have been very encouraging. With this increased activity the Government also enacted new Petroleum (Exploration and Exploitation) legislation to replace the original outmoded Oil Mines Act of 1915. Active seismic exploration is due to begin in November, and there is every likelihood that offshore drilling may take place before the end of 1979.

Background

Since the enactment of the 1915 Oil Mines Act in Fiji and up to early 1968, no companies had ever applied for oil exploration licences in Fiji. This is largely because the island arc areas of the south-west Pacific were considered too volcanic, too young, and without sufficient sedimentary basins for oil accumulation, and also too far from known petroleum provinces. The sporadic seeps that had been reported in a few parts of Fiji had been proven to be kerosene, or decaying plant matter, or too difficult to confirm, and this had not improved the situation in any way.

The recent interest in Fiji's prospectivity during the past decade stems almost totally from the discovery of genuine crude oil seepages in Tonga in 1968. Because of the Tongan oil seeps, some companies looked towards Fiji because the geology of the islands was almost completely mapped at the scale of 1:50,000 and because of the possible existence of much better and larger sedimentary basins.

In 1969 Southern Pacific Petroleum Company and Magellan Petroleum Australia Ltd carried out a reconnaissance seismic survey through the Lau Group and the Bligh Water Area. These lines showed attractive thicknesses of sediments (in excess of 2 km) in both areas. As a result, Southern Pacific Petroleum Company and Magellan Petroleum Australia Ltd applied for a licence over the Bligh Water Area (Block A). They were followed by applications for licences by OXOCO (Fiji) Ltd over the Yasawas Area (Block B), Atlantic and Oceanic Resources Ltd over the southern Lau Area (Block C), International Petroleum Ltd over the Lomaiviti-Koro Sea Area (Block D), and Investment Corporation of Fiji over the Vatulele Area (Block E). Applications which did not proceed to the licence stage had also been received from Texaco for the Great Sea Reef Area (Block F), Longreach Oil Ltd for the Natewa Bay Area (Block G), and Abrolhos (Fiji) Ltd for the northern Lau Area (Block H).

Summary of Previous Activities

The details of the petroleum exploration activities of the above companies have been covered in my earlier reports to the previous sessions of CCOP/SOPAC. In brief, between 1968 and 1975, the companies have carried out 3487 line kilometres of seismic reflection profiling and 5000 line kilometres of aeromagnetics, as well as aerial photography and land geology studies. These have shown the existence of over 6,000 m of sediments in Block A with attractive evidence of buried reefs, some sedimentary sections in the deeper waters of Block C, and some interesting sedimentary basins with buried reef evidence in Block D. However, all these licences lapsed by 1976/77 because of the downturn in overseas petroleum activity following the recessions of 1974-75, the difficulty in obtaining partners, and the lack of activity in Australia, and also because the dry holes which had been drilled off Bougainville in 1975 led companies to believe the island arc areas of the south-west Pacific were 'cold'.

Current Interest

The increased impetus of the present petroleum activity is due largely to the work of Pacific Energy and Minerals Ltd (PEML). In September 1977 this company applied for an eight-month option over the Bligh Water Area with a programme which included reinterpretation of aeromagnetic data to determine the depth to the Curie Point isotherm, and thereby determine whether the area had once been 'hot' enough to generate hydrocarbons. The option was granted in January 1978, and PEML contracted with Eureka Resource Associates Inc. of Berkeley, California, for the aeromagnetic interpretation work. The results of this interpretation were made public in July 1978, and showed that the thermal gradient of the Bligh Water Area is 40°F/1,000 feet - which is similar to the thermal gradients in some of the producing fields in Indonesia.

PEML have now exercised their option over Block A and together with MAPCO Inc. of Tulsa, Oklahoma, will soon be issued with a licence over the area. PEML have also obtained options over Block B and Block F from May 1978. Also, Dakota Exploration (Fiji) Ltd have been issued another licence over Block D which they originally held under the names of Love Oil Company and International Petroleum Ltd.

Current Programmes

For their options over Blocks B and F, PEML are currently carrying out a detailed geothermal sampling programme over Viti Levu and Vanua Levu to get a better picture of the heat regime of the Fiji Group. This programme has already delineated areas which may warrant further detailed investigation by the Government for geothermal energy. Also, PEML are carrying out detailed colour aerial photography over their option and licence areas to better locate the uncharted reefs, so that their seismic programme can be executed safely.

In November, a Western Geophysical seismic vessel is expected to begin a four-month detailed seismic exploration programme over Blocks A, B, D, and F for the licence holders. It is anticipated that this seismic programme will be the forerunner to offshore drilling activity by late 1979. According to exploration agreement with Government, both Dakota and PEML/MAPCO are expected to begin drilling in their licence areas within three years.

Legislation

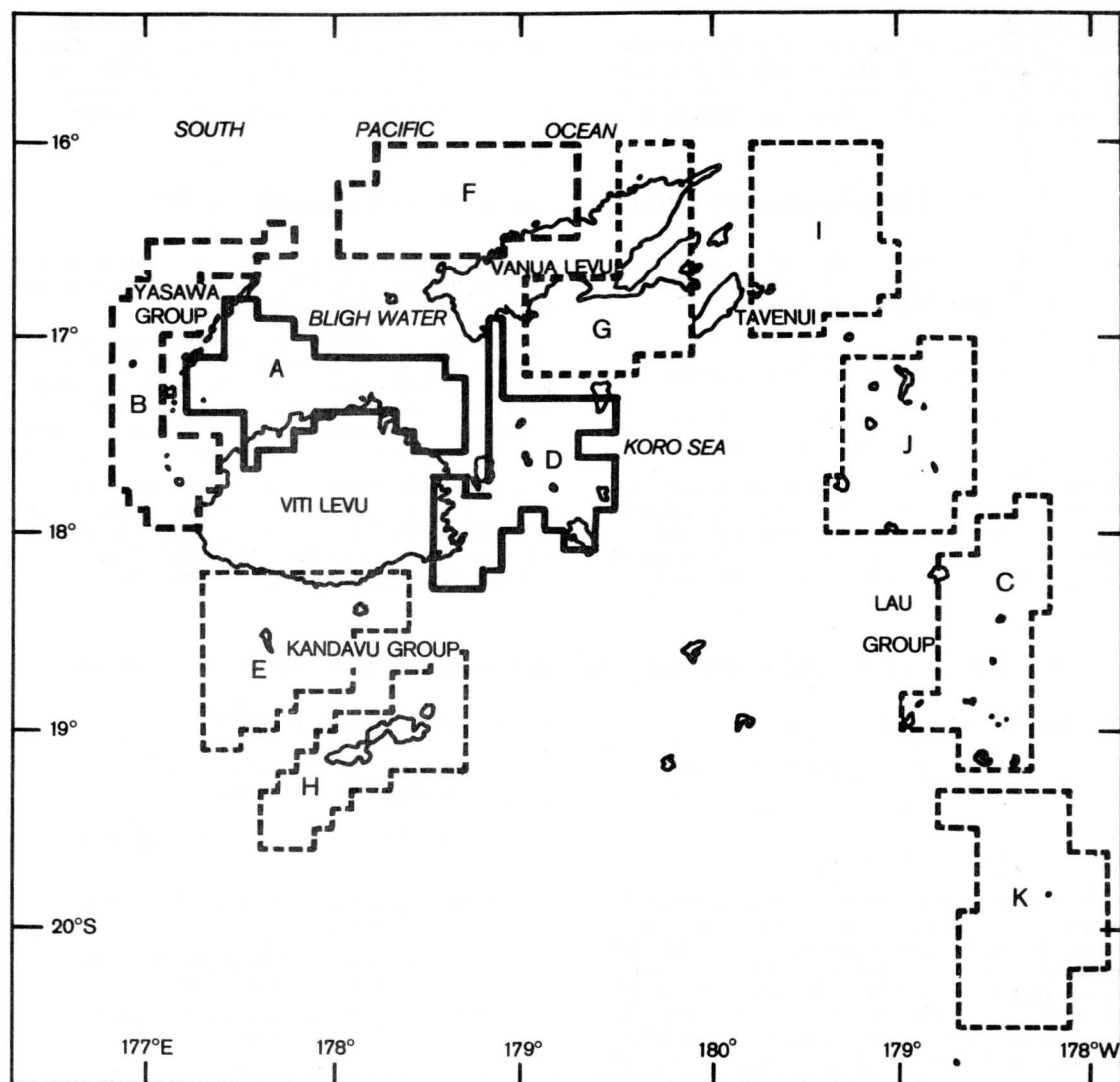
The 1915 Oil Mines Act is outmoded, since it deals exclusively with exploration on land. It was never updated because it was never put to use until 1968.

With the initial interest from 1968 onwards Government granted oil exploration licences under the 1915 Oil Mines Act, but in terms of special agreements negotiated with the companies. These agreements were based largely on Australian Petroleum practices, and included provisions concerning exploration expenditure and controls during the exploration and production phases.

With the renewal of interest this year, the Fiji Government has now enacted a new Petroleum (Exploration and Exploitation) Act to govern the administration of petroleum exploration and exploitation activities in Fiji. The Act is similar to Australian and Malaysian legislation.

The main features of the legislation are that oil petroleum resources belong to the Crown; the Fiji area is divided into a graticular system of blocks measuring 6 minutes by arc of latitude by 6 minutes by arc of longitude, with licences available over a maximum of 70 contiguous blocks; and surrender provisions are such that 50% of the licence area has to be surrendered at each renewal period. Exploration licences are granted initially for five years, and renewed thereafter for periods of three years each. All licencees are required to submit work and expenditure programmes to the satisfaction of the Minister.

Upon discovery of petroleum the licensee is given preferential rights for a production licence over a maximum of 9 blocks surrounding a location. Royalty rates are 10% minimum and 12½% maximum of the well-head value, if all 9 blocks are included in the production licence. These production licences run for 21 years, with a right to renew for a further 21 years. Provisions are also made for pipeline licences, damage and compensation, work practices, and the delivery of crude oil to any Fiji refinery. The Crown also has the right to reserve areas, and to call tenders for the grant of exploration licences over those areas. By policy, corridor blocks are maintained by Government between licence areas, and the surrender provisions for the exploration and production licences allow ample opportunity for Government to call for tenders should petroleum be struck in Fiji.



OIL EXPLORATION LICENCES AND AVAILABLE AREAS

OCTOBER 1978

(Based on a map prepared by Mineral Resources Division)

- BLOCK A: Bligh Water, 2881 square miles, under licence to Mapco/Pacific Energy and Minerals Ltd
- BLOCK D: Lomaiviti, 3010 square miles, under licence to Dakota Exploration (Fiji) Ltd
- BLOCK B: Yasawa, 3010 square miles, under option to Pacific Energy and Minerals Ltd
- BLOCK F: Great Sea Reef, 3010 square miles, under option to Pacific Energy and Minerals Ltd
- BLOCK G: Thakaundrove area, 3010 square miles, application under consideration

Conclusions

With the passage of the Petroleum (Exploration and Exploitation) Act and the active geothermal, photogeology, and seismic exploration programme over the coming years, we anticipate

much greater progress in furthering petroleum exploration than in any previous period. Also, the results of the oil drilling programme for the end of 1979 will certainly be awaited by the people of Fiji with very great interest.

I. Deep-sea nodules and mineralization in the South Pacific

22. CHEMICAL ANALYSIS RESULTS ABOUT METAL CONTENTS OF POLYMETALLIC NODULE SAMPLES IN THE COOK ISLANDS ARCHIPELAGO

(Abstracted from
Document NR/CCOP/SOPAC (7)/CR.28)

J. Recy, F. Missegue, & M. Monzier
ORSTOM, New Caledonia

During the Danaides 2 (February 1977) and Geotransit 2 (March-April 1977) cruises, carried out by ORSTOM, 105 drops of free-fall grabs were realised at 23 stations. The location of these stations was chosen to complete a pre-

liminary survey carried out over the same area in 1976 by the CCOP/SOPAC Technical Secretariat and the Cook Islands Government.

The weight of nodules per square metre on the bottom, calculated from the free-fall grab's active surface and the sampling weight, is more than 20 kg per m² in some places, but the results of the chemical analyses are not interesting from an economic point of view.

The combined weight of Co, Cu, and Ni is almost always less than 2%, and is generally less than 1%. These results are similar to those obtained on the samples of the CCOP/SOPAC - Cook Islands Offshore Survey (8-26 June 1976).

J. Beach, shelf, and slope minerals (including coral) in the South Pacific

23. APIA HARBOUR SURVEY (ABSTRACT)

(Document NR/CCOP/SOPAC (7)/CR.25)

A. John Halunen, Jr

CCOP/SOPAC Technical Secretariat

A seismic survey of the inner portion of Apia Harbour, consisting of seven track lines of 7 kHz sub-bottom reflection profiling, was carried out using a Government Fisheries Department catamaran and CCOP/SOPAC equipment on 24-26 April 1978. The objective of the survey was to delineate sub-bottom structures, preliminary to more expensive drilling to establish engineering data for eventual construction of a roll-on/roll-off docking facility and a floating dry-dock facility.

No acoustic reflectors were seen in water depths of less than about 20 feet. In the deeper portions of the harbour a clear reflector was seen at a water depth of about 30-40 feet; its apparent thickness was 20-30 feet (assuming a velocity through the overlying layer of 4800 feet/second). Assuming this layer to be horizontal and homogeneous, its velocity was estimated to be 5488 feet/second. Harbour-bottom samples collected by SCUBA tended to confirm this observation.

The lack of acoustic reflectors in the shallow areas suggests either a lack of geological layering with acoustic properties that would give a reflection, or that the uppermost layer has a velocity higher than those beneath. The deeper areas of the harbour are sedimented with a layer about 30 feet thick.

24. RAROTONGA NEAR-SHORE SURVEY

(Abstracted from
Document NR/CCOP/SOPAC (7)/CR.5)

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Cook Islands

At the Fifth and Sixth Sessions of CCOP/SOPAC, reports were presented on the likely occurrence of precious coral in the South Pacific and on the possibilities for mining submarine sands for construction purposes. Since both precious coral and construction sand could, if wisely managed, be of value for an expanding tourist trade, two new projects (CCSP-1/CK.3 and CCSP-1/CK.4) were formulated in the Cook Islands Work Programme.

It was decided that both projects should be investigated in May 1978 by a combined team from the New Zealand Oceanographic Institute and the Cook Islands Survey Department, operating under the auspices of CCOP/SOPAC.

Areas meriting detailed examination for sand, precious coral, or indeed any other submarine resources are commonly delimited initially by bathymetric information. Sand might reasonably be expected on flat terraces or flat-floored channels, whereas precious coral might be

expected on precipitous slopes or on current-scoured saddles and offshore knolls. With so little information available the initial part of the programme was necessarily a bathymetric survey, followed by a programme of sediment sampling, diving, and side-scan surveys.

The bathymetric survey revealed a flat terrace outside the reef around most of the island and out to a depth of 18-25 m, but side-scan and diving observations showed this terrace to be mainly covered by dead coral. The survey also showed flat-floored channels outside the six main passages, and these contained algal sand and coral gravel apparently washed from inside the lagoon. The channels on the northern side of the island, off the main settlements of Avarua and Avatiu, are particularly wide at relatively shallow depths, and contain a high proportion of terrigenous basaltic material. Given the demand, these could possibly provide a suitable source of construction material.

The bathymetric survey also revealed steep slopes where precious coral might be expected to occur. A steep drop-off at depths of 40-70 m off Titikaveka was investigated for black coral by diving, but despite exceptional clarity of water none was found.

The bathymetric survey did not highlight any particularly suitable environments for precious pink coral, which prefers rocky outcrops and strong currents at depths of 350-475 m. At most places at the appropriate depth the sea floor appeared to be a smooth debris slope with no channels or rocky seamounts that might exaggerate deep currents. In addition, the small size of the launch used and deteriorating weather made it impractical to use tangle nets to search for precious coral.

One notable feature of Rarotonga was the dearth of living coral on and outside the reef. Inquiries suggest that this may be a phenomenon of the past few decades.

25. SAND SURVEY OF THE BEACHES OF TONGATAPU

(Document NR/CCOP/SOPAC (7)/CR.26)

J.V. Eade¹, F. Kitike'aho², & S. Soakai²

¹ CCOP/SOPAC Technical Secretariat

² Department of Lands, Survey and Natural Resources, Tonga

Sand requirements for Tongatapu are satisfied by the mining of coarse, well-sorted calcareous sands from the beaches of Tongatapu that face the open ocean. These beaches are small, and this resource is limited. Present demands are being satisfied by a controlled system of mining under the control of beach officers. This system appears to be managing the resource sufficiently to allow the recovery of beaches.

A survey was started in July to carry out an inventory of sand on Tongatapu, study the

source of sand and the recovery rate of beaches mined, and establish whether or not mining is having a long-term damaging effect on the beaches, some of which are also used by the tourist industry.

26. NEAR-SHORE SURVEYS OFF TONGATAPU, TONGA, FOR PRECIOUS CORALS AND SAND, 7-17 JUNE 1978

(Abstracted from
Document NR/CCOP/SOPAC (7)/CR.30)

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The seabed off the Nuku'alofa waterfront is flat, and floored with muddy fine sand. North of this area, along the main shipping channel, the sediments are thinner and coarser, with increasing numbers of coral boulders and coral heads. Small fans of coarse sand and coral boulders lie at the base of all reef drop-offs within the harbour. Larger accumulations of coarser sand occur off Makaha'a and Pangaimotu Islands, especially south of Pangaimotu. Large supplies of sand occur along the reef from Fafa and Monuafa Islands to Fukave, Ata, and Tau Islands. Coral gravel and rocky bottom is found in the Narrows.

From sediment distribution it appears that bottom currents are strong in the northern part of the harbour west and south of Fafa Island and across to the Narrows. South of this, immediately off Nuku'alofa, bottom currents are much weaker.

In Piha Channel the bottom is U-shaped in profile. Steep reef drop-offs on either side of the channel descend to an irregular-shaped seabed which lies at about 100 m south of Onevai Island and descends to more than 500 m between Euaiki Island and Niutoua Village on Tongatapu. An area 2 nautical miles long by ½ nautical mile wide of rocky bottom lies south of Motutapu Island and Fukave Island. Here depths are 300-450 m, within the preferred depth range for *Corallium* elsewhere. Ten dredgings were made, and a variety of ahermatypic corals and bryozoans were recovered. No traces of *Corallium* or other jewel coral were found. It appears that although rocky bottoms exist within the preferred depth range, bottom currents may not be strong enough for *Corallium* to establish itself and survive.

A brief survey was also made of the eastern channel north of Tau Island. Here there is also rocky bottom, but no *Corallium* was recovered in the one dredging made.

27. BLACK CORAL IN TONGAN WATERS

(Document NR/CCOP/SOPAC (7)/CR.1)

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Before the CCOP/SOPAC survey for precious corals, staff from the Tongan Department of Lands, Survey and Natural Resources collected information about black coral from local business people and divers. During the survey, staff from N.Z. Oceanographic Institute, Wellington, New Zealand, collected further information from likely areas by diving and by the use of side-scan sonar. Although there was a natural reticence on the part of business people and divers to disclose information, and the survey itself was very limited as to time and facilities, the existence of black coral was verified.

In discussions with local divers and business people, four areas were frequently mentioned. Some information was given about currents, terrain, and depth. The depths, however, should be treated with some skepticism because none of the local divers wear depth gauges. No breathing apparatus is used and, even allowing for exceptional free-diving ability, it is doubtful if any coral is collected from a depth greater than 30 m. The areas are :

- (1) Tofua Island, 150 km to the north of Tongatapu; the depth mentioned was about 30 m.
- (2) Hakau Mamq'o, a flat-topped, steep-sided reef about 16 km north of Nuku'alofa. This was a reliable report from a diver who said he collected black coral from a depth of 21-24 m. He described the area as having strong currents, and steep slopes broken by terrace ledges. The black coral was found on the ledges rather than the slope.
- (3) Malinoa, a flat-topped reef with gentle slopes 13 km NNE of Nuku'alofa.
- (4) Atata, a low island 11 km NW of Nuku'alofa. The black coral was presumably found to the

north of Atata in the current-swept Egeria Channel.

Surveys with side-scan sonar revealed four areas of steep slope and rocky bottom near to Nuku'alofa, and dives were made on these sites, as follows.

Dive 1: northern side of Ualanga Uta shoal, a flat-topped, steep-sided reef about 2 km north of Nuku'alofa.

A 30° slope at the foot of the reef was broken by rock outcrops, the occasional one being about 4 m high. A single black coral sample was recovered from a 40 cm high outcrop at exactly 20 m depth. The sample, which had no living polyps, had two trunks 30 cm long, each separately attached to the substrate. The maximum diameter was 8 mm, but there was little branching growth.

Dive 2: south-western side of Fafa Island, a low island 6.5 km NE of Nuku'alofa.

An area of apparently suitable terrain and depth was located by side-scan sonar, but after the side-scan was retrieved we had drifted away and the terrain encountered on the dive was definitely unsuitable for black coral. The seabed was a flat expanse of white sand, broken only occasionally by small coral outcrops.

Dive 3: at the western beacon on Ualanga Lulu shoal, a flat-topped steep-sided reef about 4 km north of Nuku'alofa.

The slope and terrain evident on side-scan and on the dive were very similar to Dive 1. At a large, 10 m high rock outcrop a small, live tree of branching black coral was recovered at 23 m depth. The coral had dull red polyps, and measured 30 cm high.

Dive 4: 200 m NW of the No. 2 channel marker buoy in the northern shipping channel about 14 km north of Nuku'alofa.

Side-scan sonar runs made immediately before this dive showed the area to have large coral plateaux about 20 m across by 4 m high with smaller sand channels in between. The divers explored several of these plateaux, and although there was abundant coral and fish life, no black coral was seen.

K. Potentials for sea-floor mining

28. ANNUAL REPORT ON THE REVOLVING FUNDS FOR NATURAL RESOURCE EXPLORATION

(Abstracted from
Document NR/CCOP/SOPAC (7)/CR.39)

ESCAP Secretariat

The concept of the Fund was originally developed in the early 1970s as an out-growth of increasing interest among developing countries

in stepping up the development of their natural resources. This interest coincided with a perceptible decline in mineral exploration by international mining companies which traditionally finance the major part of high-risk exploration in developing countries. It is still difficult for developing countries to secure high-risk financing, particularly for mineral exploration, so the role envisaged for the United Nations Revolving Fund is more relevant than ever.

29. REPORT ON THE UNITED NATIONS EXPERT GROUP
MEETING ON SEABED MINERAL RESOURCES
ASSESSMENT

(Abstracted from
Document NR/CCOP/SOPAC (7)/CR.38)

ESCAP Secretariat

Impact of manganese nodule production on the
world's mineral economics

Figures compiled by the United States Bureau of Mines indicated that the expected nodule production would have small impact on the world's mineral economics at least until 1990, except in the case of cobalt.

Nickel derived from nodules would be competing with new markets, and would not supplant current land-based nickel production. Also, it was not likely that manganese derived from ocean nodules would be competitive with high-grade terrestrial ores as long as they remained commercially available.

It seemed from the current information that nodule resources were not as vast as popularly conceived, and their highly variable abundance served to highlight the fact that the nodule industry did not represent a bonanza business.

It was generally agreed that the mining of metals from nodules was likely to be economically viable if the average combined nickel and copper content was about 2.25 percent in areas where the average abundance of the nodules was about 10 (wet) kilograms per square metre. These figures might be used in calculating reserves. In estimating resources, 1.5 percent combined metal content and 5 kg/m² abundance might be used, which might be workable in future (possibly in 25 years' time). A viable mining operation would require 3 million (dry) tonnes of the nodules a year for at least 20 years, although some had suggested that the duration should be 40 years.

Mining of nodules

The mining systems under development had four major components.

1. *Nodule collector.* A production level of three million (dry) tonnes of nodules a year would require a wide (up to 30 m) collector operating on the sea bottom.
2. *Materials elevation.* There were three methods to elevate gathered nodules to the ocean surface: airlift, hydraulic, and the continuous-line bucket. The most promising appeared to be the hydraulic, which might be tested on a full-scale basis in 1979.
3. *Mining ship.* The first mining ships were expected to be similar to a self-propelled, dynamic-positioned drilling ship, with storage capacity for nodules of about a week, capability to transfer the nodules to ore carriers, and enlarged accommodation for the crew. The mining ship might be required to support some preliminary processing.

4. Conventional bulk, slurry, or ore-bulk-oil vessels, probably greater than 30,000 tonnes, would be used for ocean transportation with provision for loading at sea.

Selection of a mine site

Given an area containing, as a whole, nodules of adequate average grade and abundance, a portion of that area would not be mined owing to topographic obstructions, adverse bottom conditions, and the existence of patches in which nodules were below cut-off grade and/or abundance. Considering the part of the mine site in which mining would be attempted, the proportion of the nodules that could be recovered would further depend on the efficiency of the mining systems used. In calculating the area requirements for a mine, these site factors must be taken into consideration, as well as the uncertainty associated with their estimation.

Uncertainty in judgement of pertinent factors precluded the possibility of specifying any single mine site size that would approach the minimum requirements of all operators. Estimates indicated that some sites with sufficient reserves for a 20-year mine life producing at 3 million (dry) tonnes per year might be as small as 18,000 km² or as large as 55,000 km².

A large standard mine site size or individually calculated mine sites were two alternatives.

The large standard size had the advantage of simplicity and minimal administrative requirements, but might diminish the near-term availability of viable mine sites and increase the possibility that a relatively small number of companies and/or states could control the most readily exploitable portion of the resource.

Appropriate calculation of each individual mine site area for each mining operation, while tending to make more mine sites available, would place a considerable administrative burden on the managing agency. However, it remained to be seen whether or not the factors used to calculate area requirements could be determined in a satisfactory manner.

Processing

Processing of nodules was a key concern. Capital investment for the process plant generally overshadowed that for mining by a factor of about two, and nodules would not be an attractive source of non-ferrous metals until economic techniques for extracting the metal values were available.

The two principal metal production methods were the pyrometallurgical process, which required recovery of manganese, and the hydrometallurgical process, which did not.

The decision to use a process that produced, or did not produce, a manganese product was largely one involving the demand for manganese. United Nations statistical data showed the

growth of nickel production in the world over the 1966-1975 period to be 6.3 percent per year, which was in excess of the 5.6 percent growth rate in the World Industrial Production Index. On the other hand, world manganese output had grown at only 3.8 percent per year over the same period. A decision to commit substantial capital funds into the facilities to produce manganese from nodules was difficult to justify when the growth rate was substantially less than that in industrial production.

Feasibility study

Before undertaking any major mineral investment, a feasibility study had to be made. Such a study would include:

- (a) Characteristics and evaluation of the ore body. This would include data on ocean currents, sea conditions, wind and weather conditions, sea bottom topography and the location of obstructions, engineering properties of the sea floor, abundance of nodules, spatial abundance of the nodules, chemical analysis of the nodules, variation in chemical analysis, physical size, the characteristics of the nodules, and so on.
- (b) A mining plan. This would describe the mining system and equipment to be used, provide a plan of operations, give detailed estimates of the capital and operating costs, and evaluate the overall technical feasibility and the transportation to shore scheme.
- (c) A metallurgical plan. This would describe the metallurgical process and equipment, detail the processing location and infrastructure required, and provide a plan of operations.
- (d) A marketing report. This would describe the quality and quantity of the products to be produced, make projections of market growth, examine existing market structure, predict prices, and so on. It would examine competitive sources and competitive costs for products. Finally, it would produce a plan for marketing the products.
- (e) Project financial analysis. This would examine detailed cost projections and evaluate financial performance, including risk analysis.

It was thus seen that, for the South Pacific and eastern Asia, the information concerning (a) alone was totally inadequate, not to mention (b) to (e) listed above.

Major consortia involved in the development of sea-bed mineral resources

There were four major consortia currently developing deep-ocean mining systems: Deepsea Ventures, Kennecott Copper, Ocean Management, and Lockheed.

All four consortia had selected the same basic design of the mining system, i.e., a nodule

collector on the ocean floor connected by a near-vertical pipe to a surface ship. The processing approaches were different, however.

All the above had been engaged in economic, exploration, and technical development for the past 15 years. The major effort in the next two years would be the proving of the mining systems.

If the mining production could be proved and the legal environment was favourable, initial production might start around 1985. It was not expected to make profit in the initial stages, and mining was likely to be carried out only in the North Pacific.

30. MINERAL RESOURCES OF THE NEW ZEALAND OFFSHORE REGION

(Abstracted from
Document NR/CCOP/SOPAC (7)/CR.23)

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New Zealand's offshore mineral resources present a similar picture, in terms of relative importance, to that obtained on a world-wide basis: by far the most valuable and important resource economically is oil and natural gas. One very large gas-condensate field is at present being developed, and should reach production stage in April 1979; there are good prospects for additional fields to exist offshore. The potential in general for oil and gas anywhere in New Zealand is certainly far greater offshore than on land.

Detrital minerals are mainly sand and gravel useful for aggregates (and pure silica sands for glass manufacturing), and ironsands for steel production. Both occur in undoubtedly large quantities. Demand for and exploitation of offshore sand and gravel are limited, and will be of only local importance, whereas ironsands also occur in beach and dune situations where production is more readily obtainable. Offshore gold deposits may occur in some areas, but exploration is relatively expensive.

Phosphorite nodules are known to cover extensive areas on the Chatham Rise, east of the South Island. Preliminary estimates indicate over 100 million tonnes of nodules at an average phosphate content of 21.5%. In the light of the very large demand in New Zealand for phosphate for fertilizer, all of which is imported, this resource could be of great benefit; however, more detailed exploration is needed to establish economic feasibility.

Manganese nodules, although abundant in the South-western Pacific deep ocean basin, have much lower Ni + Cu + Co contents than

those in the equatorial North Pacific; they are unlikely to be of commercial value to New Zealand.

31. DISTRIBUTION, COMPOSITION, AND AGE OF
SUBMARINE PHOSPHORITES ON CHATHAM RISE,
EAST OF NEW ZEALAND

(Document NR/CCOP/SOPAC (7)/CR.3)

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A belt of nodular phosphorite deposits can be traced some 480 km along the crest of the Chatham Rise between longitudes 177°E and 177°W, mostly at depths less than 400 m. Their economic potential is being investigated, particularly near the 180° meridian, where the largest accumulations of nodules occupy the broad saddle between Reserve and Matheson Banks. In this area, concentrations of phosphorite in the order of 75-80 kg/m² have been measured. Although the surface distribution is patchy, and the thick-

ness of the deposit limited, there are indications of some sub-surface continuity of the phosphorite.

The phosphorus content of nodules varies between 16% and 25% P₂O₅, the higher values tending to occur in the smallest particles. Relatively high uranium values (up to 512 ppm U₃O₈) also characterize the Chatham Rise phosphorite, with the highest values in the 10-30 mm nodule size range. Rare earth element analyses indicate higher concentrations in the smaller, more phosphatic particles, and an overall depletion in cerium and europium.

The nodules rest on a bored and eroded surface of basal Oligocene chalky and chert-bearing limestone. They consist mainly of Lower and lower Middle Miocene limestones from horizons not now locally exposed, and are typically coated by greenish-black glauconite which is almost certainly contemporaneous with associated granular glauconite, radiometrically dated as Late Miocene or Early Pliocene (5.6 ± 1 m.y.). Phosphatisation, erosion, and nodule formation are therefore attributed to Middle - Late Miocene events. There is no evidence of subsequent phosphatisation on Chatham Rise.

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