APPENDIX 9

Report of the STAR Meeting

The STAR meeting held in conjunction with the 24th Annual Session of SOPAC included 37 scientific papers presented orally, by poster, or by abstract (SOPAC Misc. Rep. 201). In addition there were two short oral presentations, one by Don Montgomery on SAR imaging capabilities from the 1995 Shuttle Imaging Radar missions, and one by Rowena Duckworth on Australian participation in ODP and the status of ODP's plans for future drilling in the SOPAC region.

The following STAR Working Groups were convened during the meeting. Their reports including conclusions and recommendations. It should be noted that the Tectonics and Ocean Drilling working groups held a joint meeting.

- Geological Hazards (Tsunami Warnings); Co-chairs: Paul Taylor, Gajendra Prasad
- Tectonics; Co-Chairs: Loren Kroenke, Stevie Nion
- Ocean Drilling; Co-chairs: Gary Greene, Rowena Duckworth
- Habitat; Co-chairs: Gary Greene, Ian Wright

In addition the following Working Groups were established or reconstituted, with co-Chairs as indicated, and will commence work no later than 2-3 months before the next SOPAC Annual Session.

- Law of the Sea (Lindsay Parson, Cristelle Pratt)
- Information Exchange (Hervé Dropsy, Bruce Davies)
- Seafloor Mapping (Chuck Helsley, Yves Lafoy)
- Coastal and Nearshore Resources and Processes (Graham Shorten, Naomi Biribo)
- Ocean Basin Mineral Resources and Technology (Mike Cruickshank, Tevita Vuibau)
- Hydrocarbons (Neville Exon, Donn Tolia)

Saimone Helu was re-elected Vice-Chairman of STAR by acclamation until the end of the next Annual Session.

The meeting noted that, at future STAR sessions, emphasis would be on 5-10 minute oral presentations linked to posters, with fewer full-length oral presentations. Contributions from young scientists in island nations will be particularly encouraged. Institution of a "best paper" award was suggested.

REPORT OF GEOLOGICAL HAZARDS (TSUNAMI WARNINGS) WORKING GROUP

The following delegates participated:

Mr Gajendra Prasad
Mr Trevor Sankey
Mr Kazuhiro Kitazawa
Dr Brenna Lorenz
Mr Donn Tolia
Dr Chuck Helsley
Mr Paul Taylor
Mr Stevie Nion
Mr Stanley Temakon

It was generally agreed that the warning issued from Pacific Tsunami Warning Centre (PTWC) and disseminated by the International Tsunami Information Centre (ITIC) in Hawaii was in reasonable time, but this warning may not always be received properly or may not be acted upon. This has resulted mainly due to a lack of understanding on what to do when such a warning is received.

Another problem identified was that it is very likely that most countries do not have a tsunami response plan or a system through which the warning can be effectively communicated or disseminated. A major deficiency in most of the countries is the level of understanding of the phenomena by the authorities and public alike.

Conclusions and Recommendations

The Working Group requested the Secretariat to ask UNDHA/SPPO to help SOPAC countries to establish a network of contact persons and investigate means of fast and efficient communication. These persons should be able to receive and forward tsunami warning messages 24 hours a day; or appropriate alternatives should be put in place. These persons should also be qualified to make an assessment of the message and advise appropriately.

The Working Group encouraged PTWC to improve its warning to southwest Pacific countries and resume dummy warnings to test the response level in each country. Response should not be transmitted to PTWC until the message has gone through the silent warning system. The Working Group encourages STAR to request the Secretariat to convey this to PTWC. The Working Group requested SOPAC to work with ITSU to examine possibilities for improved warning systems in the SOPAC region taking advantage of up-to-date communication technology.

The Working Group requested country representatives to investigate the effectiveness of their own country's tsunami warning system, if one exists at all, and also investigate whether an appropriate and effective public education campaign exists.

REPORT OF THE JOINT MEETING OF THE TECTONICS AND OCEAN DRILLING WORKING GROUPS

A joint meeting of the Tectonics and Ocean Drilling Program working groups was convened during the 24th Annual Session. In regard to the likelihood that the ODP drill ship will return to the South Pacific region as early as 1998 this Working Group felt obligated to review potential drilling objectives and to encourage SOPAC member countries and interested scientists to participate in discussions of regional tectonics that may be germane to ODP objectives.

Tectonics

The following delegates participated:
Jean-Marie Auzende
Keith Crook
Anne Felton
Chuck Helsley
Loren W. Kroenke, Chair
Yves Lafoy
Patrick Nunn
Bernard Pelletier

The Working Group heard a proposal for a new initiative entitiled "Evolution of the Melanesian Borderland Collision Zone". This initiative would focus on fundamental tectonic processes ranging from those involved in the early stages of the initiation of subduction, through commencement of back-arc basin formation, to obduction of immense thrust sheets.

The Melanesian Borderland lies sandwiched between two of the world's fastest moving lithospheric plates, the Pacific and Australia plates. Complicated by the presence of two opposing subduction zones on either side of the Melanesian Borderland collision zone, i.e., the active San Cristobal/New Hebrides subduction zone on the southern side and the fossil North Solomon/Vitiaz subduction zone on the northern side, geological relationships in this region are understandably complex. Nevertheless, sufficient geophysical data now has been acquired (e.g. SOPACMAPS data) to provisionally identify structural relationships within the collision zone.

At the western end of the collision zone, intense compressional tectonism, characterized by the emplacement of great thrust sheets, predominates. Structural deformation, severest near Malaita, includes nappe formation and anticlinal folding, both probably facilitated by the development of duplex structure. Large-scale slump/landslide activity is also ubiquitous at this end of the collision zone. In contrast, at the eastern end of the collision zone, extensional tectonism, typified by the formation of large rift grabens, predominates. These areas have also been extensively overprinted by rejuvenation of island-arc volcanism. In the transitional, central part of the collision zone, the thrust sheets and adjoining basin floors have also been overprinted by relatively recent development of divergent basin structures, including the formation of synrift volcanic and neovolcanic zones, as well as by rejuvenation of island-arc volcanism. In the Eastern Solomon Islands the data suggest that the neo-volcanic zone in the middle of a small, but well-developed, rift basin has been overthrust by the Duff Islands Ridge. This probably occurred during a recent phase of thrust faulting, concommitant, perhaps, with rejuvenation of the nearby Vitiaz Arc volcanism that formed the islands of Anuta and Fatutaka. The reported occurrence of warm springs on one of the Duff Islands supports this interpretation as it suggests that hydrothermal solutions, emanating from the neovolcanic zone, may be percolating through the thrust sheet to the island surface.

A primary component of this new initiative would be drilling into and through the thrust sheet in several key areas at the western end of collision zone to determine underlying geological/geochemical/hydrological processes, particularly along or near the decollement. Drilling in these areas could well provide much sought answers to questions as to how such vast thrust sheets were emplaced elsewhere in the world. Drilling deep into the large rift grabens postulated to be situated at the eastern end of the collision zone in the northern Fiji and southern Tuvalu EEZs is also proposed. These rift grabens form deep closed basins where anoxic conditions could have prevailed. The basins appear to contain thick sequences of sediment. A drilling transect of these basins could determine their time of formation, the record of trench formation and basin subsidence, and history of anoxia.

Sufficient data already is in hand to locate drill sites and plan an ODP drilling leg. The SOPACMAPS data set includes 1-6 channel seismic reflection profiling, gravity and magnetic data, in addition to the extensive swath bathymetry and sidescan imagery acquired over much of the region. Additional deep penetration MCS and OBS data in the Malaita area are presently being collected by Mann and Coffin using the R/V Ewing.

The recently acquired geophysical data along the Melanesian Borderland, particularly the SOPACMAPS data sets as well as new airborne magnetic data, not only provide new insight into the evolution of this complex region, but also highlight the urgent need for additional data acquisition. For example, very little information exists along the Vitiaz Trench which has played a key role in the evolution of the Borderland. SOPACMAPS only scratched the surface. Additional surveying coupled with an extensive sampling program are critical adjuncts to the SOPACMAPS surveys. Dredge sampling is urgently needed in the New Hebrides back-arc area and Melanesian Arc gap area, additional deep seismic reflection surveys are also needed in these same areas, and additional field studies are needed in the central Vanuatu islands (especially on Santo and Malakula). Thus a new SOPACMAPS 2 initiative also urgently needs to be planned and undertaken.

Ocean Drilling

The following delegates participated:

Keith Crook
Rowena Duckworth
Gary Greene, Chair
Yoshitaka Hosoi
Bernard Pelletier
David Tappin
Paul Taylor
Ian Wright

The ODP Working Group considered the possibility that an island nation would be requesting ODP to drill a single shallow hole within its EEZ while in transit at the start or end of a drilling leg within the SOPAC region; not unlike the request made for the drill hole in the Santa Barbara Channel.

The Working Group emphasized that drilling at such a site would require stringent justification in terms of both the scientific and resources assessment benefits that would be generated. The group pointed out that ODP would probably treat the proposal, in the early stages, no differently from any other proposal. Final decision, however, might be made on broader grounds of the science benefits derived from drilling.

The Working Group requested the Australian ODP Secretariat to keep the SOPAC Secretariat and relevant officers in SOPAC member countries, informed on the status of drilling proposals in their EEZ's; and to liaise with the convener of the STAR ODP Working Group (Gary Greene) to facilitate drilling in the SOPAC region.

The Working Group was informed that the ODP Executive Council had recently approved provision for Associate Member States in ODP. Associate Membership can be acquired by a single country, a consortium of countries or by an organization. Membership includes two berths aboard the drill ship on each leg, a seat on the Executive Council Planning Committee and other various committees in the ODP structure. The cost of membership is $US500,000 (annually) compared to the cost of full membership, which is $US3,000,000 (annually). A regional organization would have complete discretion as to who would be assigned the various seats on ODP committees and drilling legs. SOPAC could consider an initiative to acquire the necessary support from UN agencies, private funding foundations, the World Bank or various developed countries. A single year membership would not likely produce desirable benefits for SOPAC, therefore the goal should be assurance of long term support. It should also be noted that the International Oceanographic Commission could be a potential associate member and SOPAC has the option of pursuing cooperation with the IOC to assure itself a role in ODP.

The Law of the Sea Convention and the eventual activation of the International Seabed Authority might provide a mechanism for acquiring necessary support. Various obligations contained in the LOS Convention might result in funds being available to organizations like SOPAC for purposes of training and technical assistance related to boundary deliniation and resource exploration.

The working groups were informed of proposals previously submitted to the JOIDES office for drilling in the SOPAC region. These include drilling in the Mariana Back-arc Basin (Mariana Trough), Woodlark Basin, Manus Basin, Ontong Java Plateau, Tonga Forearc, South Pacific Gateways (off eastern New Zealand), and potentially anoxic basins in northern Fiji-southern Tuvalu.

Conclusions and Recommendations:

Noting the potential benefits of such drilling in the acquisition of basic geological data and the furthering the understanding of regional geology necessary for evaluation of both the offshore and onshore resource potential in the EEZs of the appropriate SOPAC member countries, the working groups welcomed and supported the efforts of the Ocean Drilling Program in the SOPAC region and strongly encouraged the timely scheduling of future drilling legs in the region.

The groups heard that at present, the various active proposals/LOIs are in different stages of completion. The Woodlark Basin (ranked 1 by TECP) is probably the most complete with site survey data already in the ODP databank. The data set for the Tonga Forearc (ranked 6 by LITHP and 7 by TECP) is being compiled for submission to the data-bank and a revision is planned for the January 1996 deadline and additional site survey work is also being planned. The Ontong Java Plateau (ranked near the top by LITHP) requires additional site survey data. Two additional mature proposals also exist for the Mariana Trough which require additional site survey work. It was noted that the proposal for anoxic basin drilling in southern Tuvalu-northern Fiji existed as an LOI, that needed to be expanded. The groups considered that this proposal, however, should be combined with the Tectonics Working Group new initiative.

The working groups strongly urged proponents of the drilling to continue to develop and refine their proposals in line with panel guidance from the JOIDES panels and resubmit revisions/addendum by the 1 January 1996 deadline.

The working groups further strongly recommended that site surveys be undertaken as soon as possible so as to facilitate scheduling of drilling in the region as early as possible.

It was also recommended that the SOPAC Secretariat and member states discuss the potential benefits and costs of associate membership in ODP. The scope of discussions should include individual membership, cooperative membership with IOC or membership through IOC alone. It should be noted that membership through IOC alone will result in substantially less opportunities for individual SOPAC member states. The point of contact for discussions with ODP would be Dr David Falvey, the ODP Program Manager in Washington, D.C.

Recognising the likelyhood that ODP drilling may take place as early as 1998, the group recommended that, as an expression of SOPAC's interest, an ODP representative be invited to attend the 1996-7 annual sessions of SOPAC to report on further developments in the ODP drilling program in the region.

REPORT OF THE HABITAT WORKING GROUP

The following delegates participated:
Keith Crook
Anne Felton
Gary Greene, Co-Chair
Chuck Helsley
Barbara Keating, Co-Chair
Sandy Macfarlane
Don Montgomery
Rick Podgorny
Dick Pickrill
Ian Wright

Fisheries, coral reefs, and other biological resources are of critical importance to SOPAC countries. Benthic habitats that supply both nutrient sources and refugia for fish and other economically valuable benthic fauna need to be identified if this resource is to be properly protected and managed.

Deep water fisheries present a virtually untapped resource in the SOPAC region and its development is directly related to geological and geophysical knowledge of the ocean environment. Deep water fisheries are very dependent upon knowledge of the geology of the seafloor. From a deep water fisheries point of view a habitat is defined as the physical seafloor condition (e.g. rock, sand, or mud) that allows for sustainability of a targeted species. For example, in the case of orange roughy (*Heplostethus atlanticus*) known fishing targets area are small hills (informally called "seamounts" by industry) having relief of less than 500 meters. Thus attempts are being made to identify additional appropriate "habitat" that can be used to extend the range of known fishing areas in an attempt to reduce the fishing pressure on previously known areas.

Identification of comparable "habitat" in other areas could assist in broadening the areas annually fished in the SOPAC region. Since fishing development is a relatively immediate response to the identification of suitable "habitat", one expectation may be a direct economic benefit re-

lated to the success of regional habitat assessment activity.

Coral reef ecosystems offer benefits to humankind beyond those realized for food production, tourism, recreation, aesthetics, and shoreline protection. Coral reefs are capable of sustaining innumerable coastal communities worldwide. These ecosystems also have great economic, social, and cultural importance to nations, and to the entire SOPAC region. Coral reef ecosystems are among the most biologically productive and diverse in the world; they also serve as indicators of environmental health. Developing national/regional capacity to conserve and sustainably use coral reefs and related ecosystems require a long term (decadal) commitment by SOPAC. Strategic research and monitoring programs should be an integral part of SOPAC's workplan because management of coral reefs and related ecosystems should be based on the most relevant scientific information.

Because many benthic habitats are defined by their geology (along with depth, temperature, chemistry, nutrients, currents, and other attributes), geophysical techniques are critical in determining habitat structure and lithology (rock type). Such geological descriptions then can be applied to associated biological communities.

Many different habitats exist in the SOPAC region and range from deep water seamounts to shallow water reef megahabitats. Within these megahabitats meso- to microhabitats exist. Definition and mapping of these habitats are critical to living resource management and sustaining related commercial activities such as eco-tourism.

Application of geological, geophysical and space/air remote sensing techniques to characterizing habitats is well within the capability of SOPAC. Extension of this capability by SOPAC to the biological arena would not only contribute to assisting biologists in understanding habitats, but would lead to new sources of support.

Until recently, assessment of benthic marine habitats, including coral reefs, and their biological assemblages largely has been limited to subtidal (less than around 30 m) *in situ* observations. Increased availability and use of high resolution swath bathymetric and reflectance gathering systems and underwater video systems on ROVs, submersibles, and video sleds have made fine-scale surveys in deeper water more commonplace, thereby expanding our understanding of the processes that help define these communities and the spatial scale at which these processes operate.

Marine geophysical and remote sensing methodologies used to investigate coral reef and benthic habitats include for example side scan sonar, swath bathymetric mapping, seismic reflection profiling, satellite and aircraft remote sensing. Many of these techniques use sound sources of different frequencies to produce images of surface and subsurface features. Reflected sound waves are recorded as seafloor images in aerial and cross-section views. Resultant maps of morphology, textures, and structure can be related to lithology. Space-based and aircraft-borne sensors can be used to collect certain sea surface and subsurface geophysical, oceanographic, and biological parameters important to defining benthic habitats.

Side scan sonar

Side scan images are created by reflections of sound waves from the seafloor surface. Strong reflection and shadows create images from which features such as bedrock outcrops, mud, sand, gravel, landslide scarps and debris, faults, folds, and often general lithologies (i.e. granite, volcanic rock, bedded sedimentary rock) are distinguished. These images are used to identify likely fish habitats that can be examined more closely with *in situ* equipment.

Swath bathymetry

Digital swath bathymetric data is used to image the seafloor in great detail. New systems on the market, such as Seabeam and Simrad, are capable of producing high quality bathymetry and reflectance data that can be used to characterized benthic habitats. In oceanic deep water habitats swath systems are very useful in defining megahabitats for both benthic and pelagic fisheries.

Seismic reflection profiling

Seismic reflection profiling systems also can be used to map subsurface stratigraphy and structure. This technique is commonly used to supplement interpretations of side scan sonographs and swath bathymetric data.

Seismic reflection profiles are time-distance graphs that, when corrected for true velocity of sound through the water column and seafloor, depict a geologic cross-section of the stratigraphy along the survey vessel's track. From this subsurface structures that influence seafloor morphology associated with likely habitats can be identified.

Satellite and Aircraft Remote Sensing

Satellites are efficient platforms to collect data on regional and global scales. Aircraft, on the other hand, provide local coverage.

Ocean Color

Ocean color sensors measure important biological parameters, including chlorophyll concentrations, which aid in describing nutrient concentrations and areas of upwelling. These sensors also provide a means of differentiating water masses and defining water clarity, both of which are factors in feeding patterns of certain fish species. Ocean color measurements can provide information on ocean circulation patterns, including currents and eddies, aiding in the description of nutrient transport mechanisms affecting habitat.

Infrared Measurements

Infrared (IR) sensors, such as the NOAA AVHRR instrument, can measure sea surface temperature with sufficient accuracy to allow a description of the often narrow surface temperature regimes within which certain marine species live and feed. Sea surface temperature often affects nutrient concentrations and is a means, particularly when combined with ocean color measurements, to describe ocean circulation patterns (fronts, currents, eddies) affecting habitat.

Satellite Altimetry

Measurements of sea height with space-based precision radar altimeters affords a means to identify and locate seamounts that define habitats for many fish species. These altimeters also provide a means of defining ocean circulation patterns (currents, eddies) of sufficient persistence to exist for several orbital passes of the satellite. Sea height data provided by the Geosat, ERS-1/2 and Topex/Poseidon missions are routinely available to support the description of offshore habitats.

Synthetic Aperture Radar (SAR)

SAR measurements of the ocean surface, particularly when combined with measurements from visible and IR sensors, can describe ocean circulation patterns in both coastal and open ocean regions. The all-weather, day-night capabilities of SAR make these measurements particularly useful in cloud-covered regions of the tropics. The use of geological, geophysical and remote sensing techniques can characterize benthic habitats for commercially and recreationally

important species of fishes, corals and other organisms important to a local economy. These habitats can be categorized on the basis of depth, geology, physiography and geomorphology, slope or inclination, substratum morphology, structure, texture, roughness, and associated biotic communities. All habitat categories can be modified by terminology that is applicable across many higher levels of classification. Many habitats can be described as a mosaic of several subcategories. The main objective would be to develop a common framework, based on geologic descriptors and processes, from which biologists and ecologists can describe, visualize, and interpret functional assemblages of marine benthic organisms, including coral reefs, and their habitats. A classification system of geologic characteristics of the seafloor, specific to biological applications, has been established to assist in identifying benthic habitats and is essential in evaluating marine coastal resources.

Conclusions and Recommendations:

The Working Group strongly recommends that the newly established STAR Working Group be continued and scheduled to meet again at the next STAR meeting. This Working Group should be multidisciplinary and should include biologists as well as geologists. An initial objective should be to assess living resources (possibly with data housed at the SOPAC Secretariat) using bottom morphology as a guide.

In recognizing the large potential of living resources associated with seamounts, the Working Group encouraged SOPAC to appraise seamounts for sustainable fisheries management.

As a precursor to developing a SOPAC initiative in habitat assessment, the Working Group recommended that a workshop be arranged where biological, fisheries, geological, geophysical and remote sensing experts can inform each other and SOPAC member countries of the techniques and instrumentation available for habitat characterization. Funds for this workshop should be sought from industry, regional and governmental organizations and the World Bank. If feasible, the workshop should be organized to proceed the 1996 Annual Session of SOPAC.