Intergovernmental Oceanographic Commission
Workshop Report No. 23

Westpac Workshop on the Marine Geology and Geophysics of the Northwest Pacific

Tokyo, 27-31 March 1980

Unesco

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

Workshop Report No. 23

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SUMMARY REPORT

The Scientific Workshops of the Intergovernmental Oceanographic Commission are usually jointly sponsored with other intergovernmental or non-governmental bodies. In each case, by mutual agreement, one of the sponsoring bodies assumes responsibility for publication of the final report. Copies may be requested from the publishing bodies as listed below or from the Secretary IOC, Unesco, Place de Fontenoy, 75700 Paris, France.

No.	Title	Publishing Body	Languages
1.	CCOP-IOC, 1974, Metallogenesis, Hydrocarbons and Tectonic Patterns in Eastern Asia /Report of the IDOE Workshop on/; Bangkok, Thailand, 24-29 September 1973. UNDP (CCOP), 138 p.	Office of the Project Manager UNDP/CCOP c/o ESCAP Sala Santitham Bangkok 2, Thailand	English
2.	CICAR Ichthyplankton Workshop, Mexico City, 16-27 July 1974. (Unesco Technical Paper in Marine Science, No. 20)	Division of Marine Sciences, Unesco, Place de Fontenoy, 75700 Paris, France	English Spanish
3.	Report of the IOC/GFCM/ICSEM International Workshop on Marine Pollution in the Mediterranean, Monte Carlo, 9-14 September 1974.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish
4.	Report of the Workshop on the Phenomenon known as "El Niño", Guayaquil, Ecuador 4-12 December 1974	FAO Via delle Terme di Caracalla, 00100 Rome, Italy	English Spanish
5.	IDOE International Workshop on Marine Geology and Geophysics of the Caribbean Region and its Resources, Kingston, Jamaica, 17-22 February 1975	IOC, Unesco Place de Fontenoy 75700 Paris, France	English Spanish
6.	Report of the CCOP/SOPAC-IOC IDOE International Workshop on Geology, Mineral Resources and Geophysics of the South Pacific, Suva, Fiji, 1-6 September 1975.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
7.	Report of the Scientific Workshop to initiate planning for a co-operative investigation in the North and Central Western Indian Ocean, organized within the IDOE under the sponsorship of IOC/FAO (IOFC)/UNESCO/EAC, Nairobi, Kenya, 25 March- 2 April 1976.	IOC, Unesco Place de Fontenoy 75700 Paris, France	Full text (English only) Extract and Recommendations: French Spanish Russian

No.	Title	Publishing Body	Languages
8.	Joint IOC/FAO (IPFC)/UNEP International Workshop on Marine Pollution in East Asian Waters, Penang, 7-13 April 1976	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
9.	IOC/CMG/SCOR Second International Workshop on Marine Geoscience, Mauritius, 9-13 August 1976	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish Russian
10.	IOC/WMO Second Workshop on Marine Pollution (Petroleum) Monitoring, Monaco, 14-18 June 1976	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish Russian
11.	Report of the IOC/FAO/UNEP International Workshop on Marine Pollution in the Caribbean and Adjacent Regions, Port of Spain, Trinidad, 13-17 December 1976	IOC, Unesco Place de Fontenoy 75700 Paris, France	English Spanish
11. Suppl.	Collected contributions of invited lecturers and authors to the IOC/FAO/UNEP International Workshop on Marine Pollution in the Caribbean and Adjacent Regions, Port of Spain, Trinidad, 13-17 December 1976	IOC, Unesco Place de Fontenoy 75700 Paris, France	English Spanish
12.	Report of the IOCARIBE Interdisciplinary Workshop on Scientific Programmes in Support of Fisheries Projects, Fort-de-France, Martinique, 28 November-2 December 1977	IOC, Unesco Place de Fontenoy 75700 Paris, France	English Spanish
13.	Report of the IOCARIBE Workshop on Environmental Geology of the Caribbean Coastal Area, 16-18 January 1978	IOC, Unesco Place de Fontenoy 75700 Paris, France	English Spanish
14.	IOC/FAO/WHO/UNEP International Workshop on Marine Pollution in the Gulf of Guinea and Adjacent Areas, Abidjan, Ivory Coast, 2-9 May 1978.	UNEP Palais des Nations 1211 Geneva 20 Switzerland	English French
15.	CPPS/FAO/IOC/UNEP International Workshop on Marine Pollution in the South-east Pacific Santiago de Chile 6-10 November 1978	IOC, Unesco Place de Fontenoy 75700 Paris, France CPPS Dir. de Soberania Maritima Ministerio de Relaciones Exteriores Lima Peru	English Spanish

No.	Title	Publishing Body	Languages
16	Workshop on the Western Pacific Tokyo, 19-20 February 1979	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Russian
17.	Joint IOC/WMO Workshop on Oceanographic Products and the IGOSS Data Processing and Services System (IDPSS) Moscow, 9-11 April 1979	IOC, Unesco	English
17. Suppl.	Papers submitted to the Joint IOC/WMO Seminar on Oceanographic Products and the IGOSS Data Processing and Services System Moscow, 2-6 April 1979	IOC, Unesco	English
18.	IOC/Unesco Workshop on Syllabus for Training Marine Technicians Miami, 22-26 May 1978	Division of Marine Sciences, Unesco	English French Spanish Russian
19.	IOC Workshop on Marine Science Syllabus for Secondary Schools Llantwit Major, South Wales	Division of Marine Sciences, Unesco	English French Spanish Russian
20.	Second CCOP-IOC Workshop on IDOE Studies of East Asia Tectonics and Resources Bandung, Indonesia, 17-21 October 1978	Office of the Project Manager UNDP/CCOP c/o ESCAP Sala Santitham Bangkok 2, Thailand	English
21.	Second IDOE Symposium on Turbulence in the Ocean Liège, Belgium, 7-18 May 1979	IOC, Unesco	English French Spanish Russian
22.	Third IOC/WMO Workshop on Marine Pollution Monitoring, New Delhi, 11-15 February 1980	IOC, France	English French Spanish Russian
23.	Westpac Workshop on the Marine Geology and Geophysics of the Northwest Pacific, Tokyo, 27-31 March 1980	IOC, France	English Russian

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SUMMARY REPORT

1. Opening of the workshop and adoption of the agenda

The Convener, Dr. Noriyuki Nasu, Ocean Research Institute of the University of Tokyo, opened the workshop and welcomed the participants. The participants adopted the agenda, a copy of which is attached (Annex I).

2. Appointment of Chairman, Co-Chairman and Rapporteur

The workshop appointed Dr. Roland von Huene, U.S. Geological Survey, as the Chairman of the workshop; Dr. Seiya Uyeda, Earthquake Research Institute of the University of Tokyo, as the Co-Chairman; and Mr. Louis B. Brown, U.S. National Science Foundation, as the Rapporteur. Experts from the following countries participated in the workshop: China, France, Indonesia, Japan, Korea (Republic of), Malaysia, New Zealand, Philippines, the Soviet Union, Thailand and the United States (cf. Annex II, List of Participants).

3. Administrative arrangements

The timetable was presented under this agenda item.

4.&5. Review of present knowledge of the geology and geophysics of the Northwest Pacific and summarizing of ongoing projects

Dr. Gunter Giermann, Deputy Secretary of the Intergovernmental Oceanographic Commission, briefly summarized IOC's overall programme in the Commission's involvement in the development of the WESTPAC Programme. He encouraged the workshop participants to focus on the development of a work plan for the implementation and international co-ordination of a limited number of specific research projects to improve our understanding of geological and geophysical processes in the Northwest Pacific.

Dr. Nasu outlined the history of WESTPAC and explained how the scientific programme for WESTPAC had been developed. He pointed out that the Programme Group for WESTPAC has a unique ability to rapidly implement any recommendations it receives from the workshop, without seeking further approval from the IOC Assembly or Executive Council (refer to IOC/WESTPAC I-16). He encouraged the participants to develop strong recommendations for the effective implementation of research projects related to:

(i) subduction processes at the convergence zones of the northwestern margins of the Pacific, including island arc development, back-arc basin origins, and sedimentary and structural histories of the marginal seas;

(ii) depositional environment and history of sedimentation in Western Pacific Basins, particularly questions related to the Tertiary depositional hiatus; and

(iii) the nature of the oceanic lithosphere, the nature and origin of oceanic plateaux, and oceanic volcanic features.

Dr. Nasu invited the workshop to augment their recommendations by designating project leaders and establishing ad hoc mechanisms for the co-ordination of recommended research activities.

A number of participants offered papers or made presentations describing recent developments and discoveries regarding the geology and geophysics of the WESTPAC region. Annex III contains the titles of these papers and presentations together with the names of the authors. Anyone interested in receiving a copy of a particular paper should contact the author directly, at the address provided in the List of Participants.

6. Identification of major research problems and elaboration of recommendations for research and training programmes

6.A Identification of major research problems

After completing its review of past and present research in the Western Pacific, the workshop proceeded to identify needs and objectives for future geological and geophysical research in the region. They did so in the three broad areas below - subduction and arc tectonics, sedimentation processes, and oceanic lithosphere.

6.A.i. Subduction and arc tectonics

Study of the problems of subduction processes is fundamental to improving our understanding of the global tectonic framework. The most challenging of these problems is the question of how trench, arc, and back-arc systems develop. The Western Pacific provides a unique opportunity for the study of these systems, because this is the only region where such features are both extensive and well-defined.

It is essential to examine these systems in a comprehensive way if we are to verify existing hypotheses that these systems all result from a common process of subduction. In order to facilitate the planning of specific research projects, however, it is convenient to divide the processes that are apparently involved in the development of these systems into three categories:

(1) trench and fore-arc processes;

(2) back-arc processes; and

(3) collision processes.

In addition, processes involving the arcs themselves, such as arc volcanism and mountain building, are closely related to the marine investigations.

Each of the three categories of processes described above is essentially both dynamical and thermal in nature. Moreover, not only are these processes recorded in evolutionary history, they are ongoing today. In some regions the subduction processes appear to be relatively straightforward, such as in the Marianas and Kuriles; in others the tectonics appear to be extremely complex, such as in the Philippine and Banda areas. In the latter areas, the oceanic subduction processes are very likely to be complicated by collisions between land masses. Even among regions in which the subduction processes appear to be relatively simple, the modes of tectonism may be quite different and have to be studied individually and then carefully compared. Obviously, to effectively study these processes will require a well-planned, long-term research programme including a complex series of both field and laboratory investigations which are both interdisciplindary and international in character.

These studies should include some which are undertaken immediately and others which are of a similar scientific priority, but may be initiated later. The first group includes projects related to subduction of ocean sediment and perhaps features of continental origin, the development of back-arc basins, and the tectonics of plate collision between two continental blocks. It is important to learn if large amounts of sediment are taken down a subduction zone and if they contribute to the production of island arc magmatism. This question can most effectively be studied in the area near the IPOD transects across the Philippine Sea and the Japan Trench.

Buoyant crustal features must impinge on the subduction zone, but their subsequent fate is unclear. Discovery of the apparent breakup of the Daiichi Kashima Seamount in the Japan Trench suggests this would be a good target for such a project. We know that marginal basins, such as the Japan Sea and Kurile Basins, developed at some point in time, but we need to date both the initial development of the basins and their subsequent histories. Lastly, we need to also initiate a study of the subduction and obduction processes that occur between converging continental blocks, such as in the southwest Mindoro Basins or the Izu collision zone, areas for which a great deal of data exists and can be studied.

The second group of recommended studies are related to tectonic erosion, magma genesis, transcurrent faulting, marginal basin crust, and hydrothermal activity. The erosion of the continental framework that occurs in the interplate shear zone should be measured, preferably again in the IPOD transect areas where a great amount of data exists. The relationship between the chemistry of arc related volcanic rock on the one hand, and rate and material subducted on the other, should be examined in the Mariana Arc and the Philippine Sea. Existing studies of transcurrent faulting should be extended offshore, especially in the Philippines, Indonesia, Papua New Guinea and the median tectonic line of southwest Japan. Examining the nature of the crust in the marginal basins of the Yellow Sea, East China and Okhotsk Seas will enable us to infer the origins of these basins. Lastly, it is important to investigate hydrothermal activity, alteration of igneous rock, crustal maturation, and associated metallogenesis in the back-arc basins of the Mindoro and Okinawa Troughs and the fore-arc basins of the Mariana Arc.

6.A.ii Sedimentary processes and cenozoic hiatuses

In the Western Pacific there are special conditions of erosion and deposition that result from active tectonism, coral growth and possible deep undercurrents. An understanding of the natural breaks in sedimentation, and the mechanisms that create them, are vital to the interpretation of all borehole and seismic records collected in the region, whether these be for scientific or economic purposes. The group decided to focus on this aspect of sedimentary processes and paleoenvironmental interpretation.

A hiatus is the time interval represented by an interruption in continuity in the geological record. However, hiatuses may involve, not only absence of sedimentary layers, but also discontinuity of fossil assemblages, of composition of sediments and of sonic velocity, even if sedimentary sequences are continuous. These varieties of discontinuity have to be comprehensively studied and interpreted systematically.

Where are these hiatuses? Analysis of a series of DSDP cores resulted in the discovery of a major hiatus, now called the "great hiatus", in the Western Pacific, extending from the Shatsky Rise to the ocean floor south of New Zealand. At some places in this region there is a major gap in the stratigraphy between the Cretaceous and the Quaternary. The geological causes of this hiatus are not known.

One concept suggests that complex Antarctic bottom currents have been scouring the bottom sediments since the Oligocene. The recent discovery of a Rossby-type current with a velocity on the order of 20 cm/sec near the Bonin Trench lends some credence to this view. It is important to learn more about the nature, extent, and variability of deep ocean currents over geologic time, if we are to verify or disprove this hypothesis.

Other important hiatuses exist in trench-slope and marginal sedimentary sequences in the Western Pacific. These may be attributed to various tectonic, eustatic, current and gravity effects. Some major unconformities, with a cycle of approximately 10 million years, may be related to tectonic coupling between the Pacific plate and island arcs which tend to uplift and subside the island arc cyclically. Therefore, it is essential to learn why, when and how such coupling occurs in various areas within the Western Pacific.

Hiatuses also occur in the development of continental shelves and coral reefs. These apparently involve a complex interaction of glacio-eustatic and tectonic changes. Understanding of these processes is important in the interpretation of depositional sequences and crustal deformation in shallow water areas, and is also significant for exploration of submarine mineral and hydrocarbon resources.

By studying hiatuses in the Western Pacific, we will be able to resolve some of the key problems of paleo-oceanography and plate tectonics. It is important to emphasize, however, that reassessment and reinterpretation of the data already obtained by the Western Pacific countries are basic and vital steps in this study, if we are to achieve the desired results.

Three major projects are proposed to achieve these objectives. These are listed in geographical order from deep sea to shallow water. First, a study should be made of the extent of hiatuses and the processes which generated them in the western basins, such as the Northwest Pacific, Philippine, East Mariana and Southwest Pacific Basins. As a part of this project it is especially important to immediately begin mapping the hiatuses, define their causes in terms of water movements and supply of sediments; and measure ongoing sediment fluxes from the water column to the ocean bottom. It is also necessary to calculate the sediment budgets for hiatuses; identify and describe ocean bottom currents; and to reconstruct the vertical tectonics of the basins.

Second, a study should be undertaken of depositional prisms and hiatuses on continental margins, such as that adjacent to Japan and the Mariana Island Arc. In this project it is essential to initially (a) define the relationship among tectonics, eustatic changes, ocean currents and slumping and their effect on the creation of slope hiatuses and (b) define the regional characteristics and aerial distribution of both sedimentary and accretionary prisms. The relationship between plate movement and uplift and subsidence on the margins should also be determined, as should the impact of physical oceanographical processes on deposition and erosion. The hiatuses on the margin should be mapped and dated and their sediment budgets should be determined.

Third, a study is recommended of hiatuses in shelf seas, such as the Yellow, Sunda, and Coral Seas, and in coral reefs. These hiatuses also need to be mapped and dated. Glacio-eustatic and tectonic sea-level changes have to be compared so that their impact on these hiatuses can be determined. Sediment budgets for the hiatuses need to be established, taking into account terrigenous sediments and subaerial weathering. Models should be developed for sedimentary diagenesis associated with these hiatuses. Lastly, the role of shallow basins as sediment traps should be evaluated.

6.A.iii Oceanic lithosphere

Studies of morphological features, such as ocean plateaux and other topographic highs, and the deeper structure beneath them may provide clues to understand the origin of the plateaux (which seem anomalous in the ocean environment), the origin of volcanoes, and the processes that occur when these features collide at a continental margin in the Western Pacific. For convenience we can divide these features into three categories of special interest: (A) ocean plateaux, (B) seamounts and coal islands and (C) oceanic lithosphere.

Ocean plateaux are large blocks with a morphology that is not easy to explain by the processes that are commonly thought to produce ocean crust. Some are known to have a continental velocity structure and in some cases continental rock has been recovered from them. Just how such continental fragments originate is a subject of much speculation.

Seamounts, especially those found in linear chains, may have developed over a point of magma generation fixed with respect to the earth's mantle. Thus their trajectories may describe the past movement of lithospheric plates. The coral caps of some seamounts record their history of submergence and add a post-volcanic history.

Present studies of oceanic lithosphere should be extended to improve our understanding of normal evolution of ocean crust which can be compared with the crust under peculiar morphologic features superposed on it.

These studies can be implemented by three specific projects. The first is to study the nature and origin of oceanic plateaux, especially the Shatsky Rise, the Amami Plateau and the Yamato Rise. The second is to study the tectonics, erosion and magmatic evolution of seamounts, such as the Magellan and Marshall Seamounts. This project would also result in improved definition of hot spot chains in these regions. The third project would study the structure and anisotropy of the oceanic lithosphere and define the characteristics of the lithosphere of marginal basins.

7. Adoption of the report and recommendations

The workshop adopted the summary report and the attached recommendations (Annex III) and list of projects (Annex V) attached to it. The participants expressed their appreciation to the Government of Japan, and especially the Japanese National Commission for Unesco, for their hosting of the meeting, all of the excellent arrangements and their gracious hospitality.

8. Closure of the workshop

The meeting was closed on Monday, 31 March, at 12.30 p.m.

ANNEX I

AGENDA

1. Opening of the Workshop and adoption of the agenda
2. Appointment of Chairman, co-chairman and Rapporteur
3. Administrative arrangements
4. Review of the present knowledge of geology and geophysics of the Northwest Pacific
5. Summarizing ongoing projects
6. Identification of major research problems and elaboration of recommendations for research and training programmes
7. Adoption of the report and recommendations
8. Closure of the workshop

ANNEX II

LIST OF PARTICIPANTS

Dr. BALCE, Guillermo	Supervising Geologist, Philippine Bureau of Mines and Geosciences, Pedro Gil, Manila, Philippines
Mr. BROWN, Louis B. (Rapporteur)	International Liaison Office, AAEO/Division of Ocean Sciences, National Science Foundation, 1800 G. Street, New York, Washington D.C. 20550, USA
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Dr. HUSSONG, Donald M. (ad hoc session chairman)	Hawaii Institute of Geophysics, University of Hawaii, Honolulu, Hawaii 96822, USA
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Mr. SAMPATTAVANIJA, Suvit	Chief, Offshore Prospecting Section, Economic Geology Division, Department of Mineral Resources, Bangkok 4, Thailand
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Dr. TAKAYANAGI, Yokichi	Professor, Faculty of Science, Tohoku University, Aza Aoba, Aramaki, Sendai City, Miyagi 980, Japan
Dr. UYEDA, Seiya (Co-chairman)	Professor, Earthquake Research Institute, The University of Tokyo, 1-1-1 Yayoi, Bunkyo-ku, Tokyo 113, Japan

Representatives of U.N. Organizations

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Dr. SHIMAZAKI, Yoshihiko	National CCOP representative Cheif, Overseas Geology Office Geological Survey of Japan

Japanese National Commission for Unesco

Dr. NASU, Noriyuki	Chairman of IOC Committee
Mr. SHINOZAWA, Kohei	Secretary-General
Mr. KATSUYA, Yuichi	
Mr. NIHIO, Masahiro	

Observer

Mr. TATSUNO, Tadao	Senior Oceanographic Data Research Officer Japan Oceanographic Data Center, Hydrographic Department, Maritime Safety Agency, 5-3-1 Tsukiji, Chuo-ku, Tokyo 104, japan

ANNEX III

RECOMMENDATIONS

The WESTPAC Workshop on Marine Geology and Geophysics of the Northwest Pacific:

1. Recommends that the Programme Group for the Western Pacific (WESTPAC) adopt the Summary Report, the attached recommendations and the proposed WESTPAC projects, at its next session in 1981;

2. Recommends that the Chairman of WESTPAC, in accordance with decision WESTPAC-I.16, consult with the WESTPAC Technical Correspondent for Marine Geology and Geophysics and the Secretary IOC to initiate the following projects of immediate concern before the next meeting of WESTPAC in 1981: I.A.1; I.A.3; I.B.2; I.C.1; II.B.1 and III.A.1;

3. Recommends that the Secretary IOC draw the attention of the Joint IOC-WESTPAC/CCOP-SOPAC Workshop on Marine Geology and Geophysics in the South Pacific, to be held in Noumea, in October 1980, to the following projects which recommend investigations in the South Pacific region: I.A.1; I.A.3; I.A.5; I.B.3; II.A.1; II.B.1; and II.C.1;

4. Recommends that the Secretary IOC inform CCOP of projects in the CCOP region, and invite CCOP to assist in the implementation of these projects;

5. Recommends that the Working Committee on Training, Education and Mutual Assistance of IOC pay particular attention to requests for assistance made in relationship with the research activities prepared by the workshop;

6. Recommends that the WESTPAC Responsible National Oceanographic Data Centre in Tokyo, pay particular attention to the collection and dissemination of data resulting from the investigations proposed by the workshop; and

7. Recommends that, once projects are approved and ready for implementation, project leaders are appointed to each project under the authority of the WESTPAC Technical Correspondent for Marine Geology and Geophysics in order to co-ordinate the project implementation.

ANNEX IV

PRESENTATIONS

Scientists who wish to receive more detailed information should contact the authors:

Balce, G.R. and Zanoria, A.S. Trenches and lithospheric belts in the Philippines.

Brown, L.B. Present status of the International Phase of Ocean Drilling and Ocean Margin Drilling Programs.

Cadet, J.P. Submersible studies on the Hellenic Trench.

Carter, L. and Heath, R.A. The western boundary undercurrent and WESTPAC.

Funan, P. and Oingdao, X. The seismo-geological characteristics of the northern Yellow Sea Islands and shores.

Hartono, H.M.S. Brief review of Banda Arc geology.

Ho, C.S. Offshore geophysical-geological exploration in Peninsular Malaysia.

Hurd, D.C. Summary of recent studies using sediment traps.

Hussong, D. Recent developments in the study of the opening of the Mariana Trough.

Inoue, E. On the drifting of Japanese Islands from Asia and opening of the Japan Sea.

Kagami, H. Identification of major problems in hiatuses.

Katsura, T. and Mogi, A. Geomorphology of Daiichi Kashima Seamount and its tectonic significance.

Kobayashi, K. Forthcoming cruises of R/V Hakuho-maru for the WESTPAC Project.

Konishi, K. Glacio-eustatic and tectonic interpretation of hiatuses found on coral reefs and multi-hole drilling in Ryukyu Islands.

Kulinich, P.G., Karp, B.Y., Kouylin, B.M. and Golovanji, A.A. Geophysical characteristics of the Northwest Pacific along the profile "Japanese Trench - Shatsky Rise - Emperor Seamounts".

Lelikov, E.P. Magmatism and metamorphic complexes of the marginal seas of the Northwest Pacific.

_____. On the USSR WESTPAC Project.

Lewis, K.B. An emergent accretionary prism and depositional hiatuses and marginal plateaux in the New Zealand region.

Mizuno, A. Regional characteristics of hiatuses in the central Pacific Basin.

Murauchi, S. Mechanism of subduction.

Nagumo, S. Evolutionary history of the Japan Trench.

_____. Geophysical implication of hiatuses.

Oh, J.K. Research activities in marine geology and the research programme in marin geotectonics around the Korean Peninsula.

Okada, H. "Great Hiatus" found in the Western Pacific. Results of DSDP researches

Park, Y.A., Cho, K.J. and Oh, J.K. Marine geology of the Yellow Sea and East China Sea. A summary of the present status of knowledge.

Sampattavanija, S. Geology of the Andama Sea - Gulf of Thailand transect.

Von Huene, R., Nasu, N. and Okada, H. Recent results of DSDP Legs 56 and 57, Japan Trench transect.

ANNEX V

LIST OF PROPOSED WESTPAC PROJECTS

I.A.1	*Sediment subduction
2	Tectonic erosion
3	*Subduction of buoyant crustal features
4	Magma genesis as a product of subduction
5	Large-scale transcurrent faulting along the West Pacific margin
I.B.1	Nature of the crust in marginal basins
2	*Dating of the marginal basins
3	Hydrothermal activity in active margin systems
I.C.1	*Tectonics of plate collision zones between continental blocks
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II.A.1	Extent and mechanisms of hiatus occurrences in deep ocean basins
II.B.1	*Tectono-eustatic and paleo-oceanographic interpretation of depositional prisms and hiatuses on continental margins
II.C.1	Glacio-eustatic and tectonic interpretation of hiatuses in shelf seas and coral reefs
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III.A.1	*Nature and origin of oceanic plateaux
III.B.1	Nature and origin of seamounts and coral islands
III.C.1	Nature and origin of oceanic lithosphere

Note: Projects of immediate concern are marked with an asterisk (*).

Project I.A.1

1. Title: Sediment subduction

2. Area of interest:

Near the present IPOD transects in the South Philippines Sea (Mariana Arc) near 18°N and the Japan Trench near 40°N. These well-studied transects provide an existing body of background knowledge, including deep-ocean scientific drilling results, which allow us to most intelligently pose our scientific questions and design the tests needed to answer these questions. The Japan and Marianas transects also serve as examples of ocean/continent and ocean/ocean plate convergence, respectively.

3. Scientific objectives:

To determine what portion of those sediments supplied to the trench axis is taken down with the subducting plate versus that which is accreted to the overriding plate. Then, what is the eventual fate of subducted sediments? What is the effect of the sediments on the tectonics of subduction (e.g. do they lubricate the shear zone between the plates? When are these sediments de-watered and what is the effect of this water on the shear zone and the arc (including volcanism)) as the water percolates through the adjacent rocks?

4. Methods of investigation:

(a) high-resolution digital seismic reflection profiles, which must include refraction data to properly process the reflection data;

(b) OBS and OBH stations;

(c) detailed heat-flow surveys to look for the thermal effects of water movement;

(d) multi-beam bathymetry on inner trench walls;

(e) high-resolution bottom sampling (dredges and cores) using multi-beam bathymetry and bottom navigation control to locate the samples;

(f) sampling by submersibles;

(g) geochemistry of arc volcanics, especially isotope studies;

(h) detailed earthquake studies to define the geometry of the interplate shear zone; and

(i) deep-towed seismic reflection data acquisition.

Note:

1. All plate convergence studies, particularly this study, which will define the sediment budget in the subduction zone, must model the trench in three spatial dimensions to account for the effects of oblique convergence.

2. It is recommended that CCOP-SEATAR and WESTPAC-CCOP/SOPAC workshop in Noumea (1980) consider the Hikurangi Trough and the Sunda Trench regions, where thick sediment cover on the oceanic plate apparently contributes to a large accretionary prism, as additional contrasting areas to study sediment subduction.

Project I.A.2

1. Title: Tectonic erosion

2. Areas of interest:

   (a) present IPOD transects of the Mariana and Japan Trenches, as in Project I.A.1; and

   (b) the Japan Trench just north of the present trench triple junction, where maximum tectonic erosion may be occurring.

3. Scientific objectives:

To study vertical tectonic movement of overriding plates; the budget of shear-zone sediments and rocks that are underplated to, or eroded from, the bottom of the overriding plate; the detailed geometry of the interplate shear zone; and the mode of stress relief in the plate contact zone.

4. Methods of investigation:

In addition to the techniques used to study sediment subduction, the project will require deep penetration digital seismic reflection data, detailed hypocentre and focal mechanism studies using OBS arrays, and detailed explosion refraction studies.

Project I.A.3

1. Title: Subduction of buoyant crustal features*:

2. Areas of interest:

   (a) Daiichi Kashima Seamount;

   (b) Magellan Seamounts;

   (c) Benham Rise;

   (d) Erimo Seamount; and

   (e) Meiji Seamount.

3. Scientific objectives

To determine the effect of the impingement of bathymetrically anomalous oceanic crustal features, such as seamounts and plateaux, on the subduction zone. Why do some of these features stop (or reverse) subduction whereas other features are subducted with no apparent disruption of the overriding plate?

4. Methods of investigation:

(a) high resolution bathymetry;

(b) submersible studies; and

(c) dredging of the oceanic plate bathymetric highs to determine their nature, and of the inner wall of the associated trenches to look for the remains of previously subducted oceanic plate seamounts.

Note:

We hope that CCOP-SEATAR and the WESTPAC-CCOP/SOPAC workshop will consider study of the Ontong-Java Plateau as one of the largest of these shallow oceanic crustal features. When the Ontong-Java Plateau collided with the Solomon Island arc, it apparently clogged the subduction zone where the Pacific plate had been descending from the NE and caused the reversal of subduction to the present situation where the Australian plate is descending from the southwest beneath the Solomons.

Project I.A.4

1. Title: Magma genesis as a product of subduction

2. Areas of interest:

(a) Mariana Arc and

(b) the Philippines (Didicas Islands north of Luzon and the volcanic chain offshore of Mindoro and Marinduque Islands).

3. Scientific objectives:

To determine the nature of fore-arc volcanism and the chemistry and relative activity of volcanoes as an effect of rates of subduction, dip of subducted slab, nature and amount of material being subducted, nature and tectonic stress state of overriding plate.

4. Methods of investigation:

(a) morphological and geophysical surveys on submarine volcanic features;

(b) sampling of subaerial and submarine volcanics;

(c) geochemical studies of samples; and

(d) submersible investigations and sampling.

Note:

The Emperor of China, Niewerkerk and Yersey volcanic areas of Indonesia are also excellent targets for this study, and perhaps might be considered by CCOP-SEATAR.

Project I.A.5

1. Title: Large-scale transcurrent faulting along the West Pacific margin

2. Areas of interest:

   (a) Philippine fault;

   (b) Median tectonic line of SW Japan;

   (c) Taiwan fault; and

   (d) other faults of interest.

3. Scientific objectives:

To determine the age, structural characteristics and relation to plate movements of these large-scale transcurrent faults. These faults are often easier to study in detail on land, but need to be traced offshore.

4. Methods of investigation:

   (a) seismic reflection and refraction along the offshore extension of the faults to trace their continuity and determine their structural characteristics; and

   (b) microseismic studies by ocean bottom seismometers, complemented by land-based seismometers along the fault zones.

Note:

Similar transcurrent faults are the Sorong fault in Papua New Guinea, Irian Jaya and between Banggai-Sula Islands, Sumba fracture, which might be considered by CCOP-SEATAR, and the WESTPAC-CCOP/SOPAC workshop.

Project I.B.1

1. Title: Nature of the crust in marginal basins

2. Areas of interest:

   (a) Yellow Sea;

   (b) East China Sea; and

   (c) Okhotsk Sea.

3. Scientific objectives:

To determine the origin of these basins (are they continental, back-arc basins, trapped deep-ocean basins with thick sedimentary cover, etc.?).

4. Methods of investigation:

   (a) refraction seismic and expanded spread wide-angle reflection profiles;

(b) heat flow measurements;

(c) gravity data, when required; and

(d) magnetic surveying.

Note:

Similar regions of great interest that might be considered by CCOP-SEATAR are Java Sea, Sunda Shelf, Gulf of Thailand, and the Wetar Strait.

Project I.B.2

1. Title: Dating of marginal basins*

2. Areas of interest:

(a) Japan Sea; and

(b) Kurile Basin.

3. Scientific objectives:

To date the time of opening and the period of extension of these basins.

4. Methods of investigation:

Magnetic profiles (air or sea) with sufficient detail and navigation to determine and identify spreading anomalies where they exist.

Note:

We hope that CCOP/SEATAR will consider the Java Basin, Banda Sea, Andaman Sea as regions of interest for this study.

Project I.B.3

1. Title: Hydrothermal activity in active margin systems

2. Areas of interest:

(a) back-arc - Mariana Trough, Okinawa Trough; and

(b) fore-arc - Mariana arc and other appropriate regions.

3. Scientific objectives:

To determine:

(a) the extent of hydrothermal activity in actively extensional back-arc basins to evolute its effect on crustal maturation and metallogenesis (massive sulfides); and

(b) if there is a relationship between hydrothermal activity and apparent fore-arc volcanism.

4. Methods of investigation:

(a) detailed heat flow surveys using multi-entry instruments;

(b) coring and dredging;

(c) geochemical studies of seawater (bottom water and interstitial water from sampled sediments); and

(d) sampling by submersibles.

Note:

Interesting areas for this study that might be considered by CCOP-SEATAR and the WESTPAC-CCOP/SOPAC workshop are the Bay of Plenty (N.Z.), Andaman Sea, and Banda Sea.

Project I.C.1

1. Title: Tectonics of plate collision zones between continental blocks*

2. Areas of interest:

(a) Southwest Mindoro Basin; and

(b) Izu collision zone.

3. Scientific objectives:

To study the kinematics of subduction and obduction where continental blocks converge and how they may relate to reversal and initiation of new subduction zones.

4. Methods of investigation:

(a) compilation of available geophysical and geological data collected by oil exploration companies and other agencies; plus supplemental data acquisition, especially high-resolution seismic reflection data, where required;

(b) deep seismic refraction studies using OBS and OBH;

(c) heat flow and thermal gradient studies on land and offshore;

(d) seismological studies to define the Benioff zone and earthquake focal mechanisms in the area;

(e) petrological studies, including isotopic geochemistry of related ophiolite belts and volcano-plutonic complexes;

(f) gravity studies; and

(g) correlation of offshore and onshore geology.

Note:

The Banda collision complex (Timor, Aru, Seram Trough region) is a particularly interesting continental block collision zone that might be considered by CCOP/SEATAR.

Project II.A.1

1. Title: Extent and mechanisms of hiatus occurrences in deep ocean basins

2. Areas of interest:

   (a) Northwest Pacific Basin;

   (b) Philippine Basin;

   (c) Mariana Trough and Mariana Basins;

   (d) Mid-Pacific seamount chain area; and

   (e) East and West Caroline Basins.

3. Scientific objectives: To

   *(a) map regional hiatuses for various time periods;

   (b) calculate missing volumes of material and find where the missing material has been deposited; i.e. to determine the sediment budget in terms of material balance;

   *(c) define causes of hiatuses in particular areas in terms of possible water movements and supply of sediment;

   (d) define the routes and velocity of present deep-ocean currents, particularly Western Boundary Undercurrents, and to define paleo-ocean currents from a knowledge of plate movements, build-up of ice caps (particularly in the Southern Hemisphere) and faunal and floral changes in cores;

   *(e) define ongoing fluxes of sediment from the water column to the ocean bottom; and

   (f) reconstruct mid-ocean basin vertical tectonics.

4. Methods of investigation:

   (a) echo sounding, especially the use of high-frequency (3KHz) systems;

   (b) seismic reflection, particularly multi-channel seismic profilers;

   (c) high-resolution seismic refraction techniques, using sonobuoys, OBH's and OBS's, should be further developed in order to discriminate velocity structure with adequate detail to detect hiatuses and other major sedimentary discontinuities;

   (d) standard micropaleontological, sedimentological, petrological and geochemical techniques on collected samples;

   (e) piston coring and dredge hauls;

   (f) deep-ocean drilling, especially hydraulic piston coring;

   (g) sediment traps, including:

(i) long-term moorings (ca. 12 months) using PARFLUX Mark II or similar sediment traps; and

(ii) short-term free floating traps (ca. 10 days-2 weeks); and

(h) correlation of high-resolution geophysical data with hiatuses observed in cores.

Note:

Similar studies should be undertaken in the following areas of interest to CCOP-SEATAR and the WESTPAC-CCOP/SOPAC workshop: Melanesian Basin, Coral Sea, North and South Fiji Basins, and the South Pacific Basin adjacent to New Zealand.

Project II.B.1

1. Title: Tectono-eustatic and palaeo-oceanographic interpretation of depositional prisms and hiatuses on continental margins*

2. Areas of interest:

(a) continental margin adjacent to Japan;

(b) Mariana Margin; and

(c) Japan Sea.

3. Scientific objectives: To

*(a) define the interrelationships among tectonism, eustatic changes, currents and slumping in the origin of slope hiatuses;

(b) investigate uplift and subsidence on continental margins relative to plate movement;

(c) determine the nature of present and palaeo-oceanography as they affect deposition and erosion;

(d) estimate volumes of sediment lost during hiatuses and the site of redeposition;

*(e) define regional characteristics and aerial distribution of sedimentary prisms;

*(f) define aerial distribution of accretionary prisms and define nature of ridge and basin sediments and mechanisms of deformation; and

(g) map and date hiatuses and define seismic stratigraphy on the continental margins, island arcs and marginal plateaux.

4. Methods of investigation:

(a) collect records of hiatuses from all available geological and geophysical information on margins;

(b) collect additional multi-channel, high-resolution seismic and core or borehole data from selected locations;

(c) encourage deep drilling of the margins; and

(d) develop high-resolution seismic techniques, using sonobuoys, OBS', OBH's, with deep-tow, spike pulse sources and improved techniques of recording processes and displays, to study hiatuses at slope depths.

Note:

It is recommended that the WESTPAC-CCOP/SOPAC workshop consider a similar study on the Hikurangi Margin.

Project III.C.1

1. Title: Glacio-eustatic and tectonic interpretation of hiatuses in shelf seas and coral reefs

2. Areas of interest:

(a) seas adjacent to the Ryukyu and Mariana Islands;

(b) Yellow Sea; and

(c) East and South China Seas.

3. Scientific objectives: To

*(a) map regionally traceable hiatuses within shelf sediments;

*(b) correlate glacio-eustatic sea level changes with existing hiatuses;

*(c) compare glacio-eustatic vs. tectonic sea level changes in shallow seas;

(d) consider plate movement relative to shallow-basin formation and subsequent deposition (shallow basin as a sediment trap);

*(e) compare the volume of terrigenous sediments with the volume of volcanogenic and biogenic sediments to define the total sediment budget; and

*(f) test models of sedimentary diagenesis associated with formation of hiatuses within shallow-water sediments.

4. Methods of investigation:

(a) satellite and mini-ranger navigation systems;

(b) side-scan sonar surveys;

(c) high-resolution seismic surveys;

(d) multi-hole drilling;

(e) geophysical logging of bore-holes; and

(f) vibro-coring.

Note:

Similar studies should be undertaken in the following areas of interest to CCOP-SEATAR and the WESTPAC-CCOP/SOPAC workshop: Sunda Shelf, Java Sea, Coral Sea, the Philippine Sea, Gulf of Thailand, and the northern Great Barrier Reef region.

Project III.A.1

1. Title: Nature and origin of oceanic plateaux*

2. Areas of interest:

(a) Shatsky Rise;

(b) Amami Plateau; and

(c) Yamato Rise.

3. Scientific objectives:

(a) determine tectonic evolution of ocean plateaux by studying vertical tectonics with benthic foraminiferal assemblages, carbonate and silica dissolution, detailed surface and subsurface morphology, and gravity anomalies;

(b) establish continental or oceanic nature of the crust from velocity structure, petrology of rock, and thermal structure; and

(c) define palaeo-latitude of plateaux at time of formation.

4. Methods of investigation:

(a) echo sounding, use of narrow beam sounder is preferable if possible;

(b) gravity magnetic, and heat-flow measurement;

(c) seismic reflection, use of multi-channel seismic profiler is recommended;

(d) seismic refraction, use of sonobuoy, OBH (Ocean Bottom Hydrophone), OBS (Ocean Bottom Seismometer), etc.;

(e) theoretical simulation of the present morphology on the basis of elasticity and rheology of crust and mantle;

(f) standard micropalaeontological, sedimentological, petrological and geochemical techniques on collected samples; and

(g) piston coring, dredge haul and drilling.

Note:

It is recommended that CCOP/SEATAR make similar investigations on the Benham Rise.

Project III.B.1

1. Title: Nature and origin of seamounts (volcanoes) and coral islands

2. Areas of interest:

   (a) Magellan and Marshall seamounts;

   (b) Mid-Pac seamounts;

   (c) coral and volcanic islands particularly Daito and Marcus Islands; and

   (d) isolated submarine topographic highs exposed and buried in continental shelves, slopes and marginal basins.

3. Scientific objectives:

   (a) study tectonic and erosional process common to seamounts;

   (b) determine magmatic evolution of seamounts; and

   (c) establish trajectory of hot spot chains.

4. Methods of investigation:

   (a) echo sounding, use of narrow-beam sounder is preferable, if possible;

   (b) gravity, magnetic and heat-flow measurement;

   (c) seismic reflection, particularly to reveal buried topography;

   (d) dredge hauls and other techniques to collect rocks;

   (e) standard micropalaeontological, sedimentological, petrological and geochemical techniques on collected samples;

   (f) land-based shallow and deep drilling of carbonate and igneous rock on coral islands; and

   (g) theoretical simulation of the present morphology on the basis of elasticity and rheology of oceanic crust and mantle.

Project III.C.1

1. Title: Nature and origin of oceanic lithosphere

2. Areas of interest:

   (a) two orthogonal transects east of Japan and Bonin arcs; and

   (b) Japan Basin:

3. Scientific objectives:

   (a) study structure and anisotropy of oceanic lithosphere; and

(b) determine characteristic features of lithosphere in marginal basins.

4. Methods of investigation:

(a) long-distance controlled source seismology in the oceans using OBS (Ocean Bottom Seismometer) arrays;

(b) observation of natural micro-earthquakes with an OBS array;

(c) standard oceanic measurement of gravity, magnetics and heat flow; and

(d) theoretical studies of evolution of lithosphere in normal ocean and marginal basins.

Note:

It is recommended that CCOP-SEATAR make similar investigations in the Philippine Basins.