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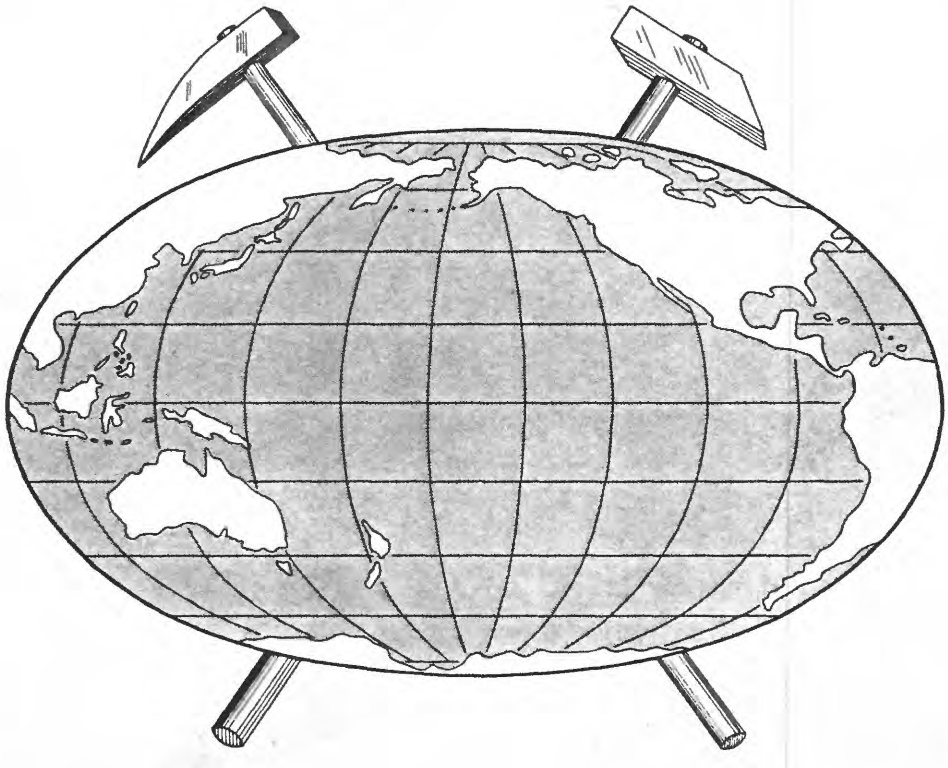
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

CIRCUM-PACIFIC MAP PROJECT: 1982 STATUS REPORT

AN ACTIVITY OF THE CIRCUM-PACIFIC COUNCIL FOR ENERGY AND MINERAL RESOURCES

PROJECT REPORT (IR)CP-10

Circum-Pacific Investigations



U.S. Geological Survey

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This report is preliminary and has not been edited or reviewed for conformity with Geological Survey standards or nomenclature

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PREFACE

The Circum-Pacific Map Project is a cooperative international effort designed to show the relationship of known energy and mineral resources to the major geologic features of the Pacific basin and surrounding continental areas. The latest geologic, mineral, and energy data are being compiled at a basic scale of 1:10,000,000 on equal-area map projections. Where feasible, the latest available data are being complemented by new, project-developed data sets such as magnetic lineations, sea-floor-mineral deposits, and sea-floor sediment. Earth scientists from more than 35 Pacific-region countries are involved in this work.

Covering more than half of the Earth's surface, the project area extends from the Indian Ocean eastward across the Pacific to include most of North and South America (figure 1). It extends from the Arctic Ocean southward to include the entire continent of Antarctica.

Five overlapping regional maps at a scale of 1:10,000,000 form the cartographic base for the project: the four quadrants of the Pacific (Northwest, Southwest, Southeast, and Northeast) and an Antarctica Sheet (figure 1). There is also a basin-wide map at a scale of 1:20,000,000. The Geographic, Base, and Plate-Tectonic Map Series, comprising 19 map sheets, have already been published. Thematic map series in preparation include Geologic, Tectonic, Geodynamic, Mineral Resources, and Energy Resources Maps (table 1). A final 1:20,000,000-scale map showing the relation of resources to the major geologic and tectonic features of the Pacific basin is also planned. Altogether, 43 map sheets are projected; to date 18 have been published and 3 were in final proof as of late 1982. The maps are being published and distributed by the American Association of Petroleum Geologists (AAPG), P.O. Box 979, Tulsa, Oklahoma 74101, U.S.A.

The framework for the Circum-Pacific Map Project was developed in the early part of 1973 by a group of 12 North American geoscientists. The project was later officially started at the time of the First Circum-Pacific Conference on Energy and Mineral Resources, which met in Honolulu, Hawaii, in mid-1974 (Halbouty and others, 1976). Actions taken at the conference, sponsored by the AAPG, the Pacific Science Association (PSA), and the Coordinating Committee for Offshore Prospecting for Mineral Resources in Asian Offshore Areas (CCOP), led to the formation of the Circum-Pacific Council for Energy and Mineral Resources. At the organizational meeting of the council, Michel T. Halbouty (figure 2) was named chairman, and the Map Project, under the chairmanship of John A. Reinemund (figure 2), was included as a principal activity of the council.

The Circum-Pacific Council promotes scientific interchanges and resource exploration through its quadrennial conferences, through the Map Project, and through scientific training seminars. At the Third Circum-Pacific Conference, 1982, the council became affiliated with the AAPG as an international division. Halbouty was named president, J. Erick Mack, Jr., was named first vice-president, Alan G. Hatley was named second vice-president, and H. Gary Greene was named secretary-treasurer. During the conference, Reinemund was advanced to

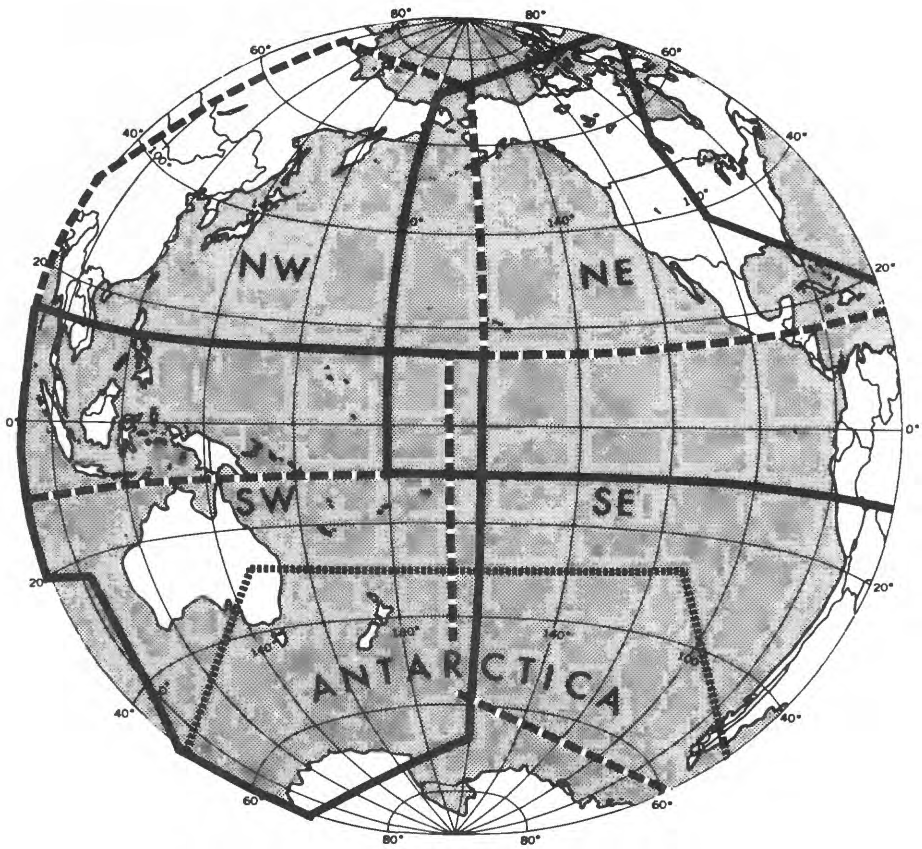

Figure 1. Index map showing boundaries of the five 1:10,000,000-scale map sheets. The Antarctica Sheet is being revised. The new northern boundary at latitude 26° S. will include all of the Australian and South American continents south of that latitude. A substantial part of the Antarctica Sheet is not shown on the index map. There is also a 1:20,000,000-scale map that covers the entire area shown.

the post of Map Project Director, a council position, and Deputy Chairman Warren O. Addicott was named to succeed Reinemund as general chairman.

The Circum-Pacific Map Project is organized under five panels of geoscientists representing national earth-science organizations, universities, and natural-resource companies. The five panels (table 2) correspond to the basic map areas (figure 1). Panel chairmen (figure 3) include Chikao Nishiwaki (Northwest Quadrant), H. Frederick Doutch (Southwest Quadrant), Campbell Craddock (Antarctica Region), Jose Corvalán (Southeast Quadrant), and Kenneth J. Drummond (Northeast Quadrant). Drummond succeeded C. A. Burk as chairman of the Northeast Quadrant Panel in 1976, Craddock succceeded F. Alton Wade as chairman of the Antarctica Panel in 1978, and Doutch succeeded Ronald N. Richmond as chairman of the Southwest Quadrant Panel in 1980. Paul W. Richards served as deputy chairman of the Map Project from 1975 until 1979; he was succeeded by Warren O. Addicott in late 1979.

Project coordination and final cartography is being carried out through the cooperation of the Office of International Geology of the U.S. Geological

Figure 2. John A. Reinemund (left), Director of the Circum-Pacific Map Project, and Michel T. Halbouty (right), Chairman of the Circum-Pacific Council for Energy and Mineral Resources.

Survey under the direction of Map Project Director John A. Reinemund of Reston, Virginia, and General Chairman Warren O. Addicott of Menlo Park, California, with the assistance of George W. Moore, Special Consultant for Marine Geology and Resources. Scientific coordination is guided by Maurice J. Terman of Reston. Project headquarters are located at 345 Middlefield Road, MS 52, Menlo Park, California 94025, U.S.A.

An annual meeting of the panel chairmen, committee chairmen, and map consultants has been held in May of each year since 1975, usually at Menlo Park, California. This report summarizes actions taken at the 1982 Map Project meeting and the status of the project as of September 1982. A summary of a special Interim Meeting of the Map Committee held in August 1982 is also included.

The Circum-Pacific Map Project has been sustained during its nine years of operation through appreciable contributions in staffing, data, and services by more than 35 participating countries and some 135 cooperating organizations (table 3).

Figure 3. Map Project Panel Chairmen at the 1981 Map Project meeting, Menlo Park, California (left to right): Campbell Craddock, Madison, Wisconsin, U.S.A., Antarctica Region; Chikao Nishiwaki, Tokyo, Japan, Northwest Quadrant; Kenneth J. Drummond, Toronto, Ontario, Canada, Northeast Quadrant; José Corvalán, Santiago, Chile, Southeast Quadrant; H. Frederick Doutch, Canberra, Australia, Southwest Quadrant.

INTRODUCTION

As 1982 draws to a close, the Circum-Pacific Map Project is nearing the halfway point in publication of the planned 43-map series and is working toward a target of completing this phase of the project in about three years (table 1). Since issuance of the last project report, which summarized the status of map compilation as of mid-1980 (Addicott, 1980), a series of six Plate-Tectonic Maps (Corvalán, 1981, Craddock, 1981, Doutch, 1981a, Drummond, 1981, Nishiwaki, 1981, and Drummond and others, 1982) and an explanatory booklet (Moore, 1982) have been published. Five thematic map series, comprising 25 map sheets, remain to be completed and published. Work on three of these series--Geologic, Mineral Resources, and Energy--has progressed to the point of making several color proofs. Publication of two maps in the Geologic Series (Northeast and Southeast Quadrants) and one Mineral Resources Map sheet (Northeast Quadrant) is scheduled for the first half of 1983.

Figure 4. 1981 Map Project meeting held in Menlo Park, California.

With Map Project work moving into the final stages of compilation and cartography, attention of the Map Committee has turned, this year, toward an examination of what future efforts might be undertaken following the completion of this phase of the work. Continuing and expanding the effort into new areas of investigation were considered favorably by the Map Committee and map advisors. Future plans were discussed by Map Project Director John A. Reinemund and Circum-Pacific Council Chairman Michel T. Halbouty (figure 2) at a meeting with U.S. Geological Survey Director Dallas L. Peck and Chief Geologist Robert M. Hamilton in April 1982 in Reston, Virginia. Further consideration of possibilities for future phases of work was undertaken at the subsequent meetings of the panel chairmen in Reston, Virginia, and Honolulu, Hawaii. Topics under consideration include: revision and updating of the thematic map series; development of regional maps at larger scales in priority areas; compilation and computerization of resource and geologic data used on the maps; preparation of paleogeologic maps on the 1:20,000,000-scale base; geologic-hazard studies; preparation of cross sections; preparation of syntheses; and one or more summary reports.

At the August panel chairmen's meeting in Honolulu, a new experimental or interpretive map series was discussed and provisionally adopted pending completion and review of initial map manuscripts. Under consideration for publication in this format is a 1:10,000,000-scale map of the Northeast Quadrant prepared by John P. Albers, showing accretionary terrane and mineralized belts. Another map to be considered for publication in this provisional series shows accreted terranes on the 1:20,000,000-scale Pacific Basin base (Jones, Howell, and Schermer, 1982).

Figure 5. Participants in the Map Project meeting, Menlo Park, California, May 27-29, 1981.

The present report is a summation of the status of the Circum-Pacific Map Project as of September 1, 1982. Its purpose is to recapitulate two panel chairmen's meetings held during 1982, and also to present updated compilation guidelines for the five thematic maps remaining to be published. This summary supercedes the last project status report (Addicott, 1980). Actions taken at the 1981 Map Project meeting held in Menlo Park, California (figures 4 and 5) were outlined in an interim report (Addicott, 1981).

ACKNOWLEDGEMENTS

This report was prepared with the cooperation of members of the Map Committee who have provided drafts of the updated compilation guidelines and have participated in many other ways in the preparation of this document. A status report presented at the Third Circum-Pacific Conference on Energy and Mineral Resources by Map Project Director John A. Reinemund (Reinemund and others, 1982) has also been used in drawing this report together. The bulk of this summary is from tape recordings made during the panel chairmen's meetings in Reston, Virginia, and Honolulu, Hawaii, that were transcribed by Anne Gartner. Photography is by Lowell W. Kohnitz, Bradford Ito, Joseph Barrar, William A. Dize, and Warren O. Addicott.

ANNUAL MAP PROJECT MEETING

Introduction

More than 40 Circum-Pacific Map Committee members and observers (tables 4 and 5) met during the period June 10 to 13, 1982, in Washington, D.C., and Reston, Virginia, for the eighth annual Map Project meeting. The opening session of the four-day meeting, held at the U.S. National Academy of Sciences on May 10, included a congressional and press briefing that dealt with the Map Project and also plans for the Third Circum-Pacific Conference on Energy and Mineral Resources in Honolulu in August 1982. Moving on May 11 to Reston, Virginia, headquarters of the U.S. Geological Survey, the committee (figure 6) undertook an intensive review of the six series of thematic maps.

Evaluation of initial color proofs of the Northeast and Southeast Quadrant Geologic Map sheets was a principal focus of the meeting. A goal of completing all compilation for the Geologic Map Series by January 1983 was agreed upon by the panel chairmen. The committee also reviewed a color proof of the Northeast Quadrant Mineral Resources Map prepared under the direction of map advisor Philip W. Guild, which included data on sea-floor-mineral localities. Consideration of a preliminary tectonic-map compilation of part of the Southwest Quadrant prepared by Erwin Scheibner provided a basis for reaching agreement on a set of revised compilation guidelines for the Tectonic Map Series. The meeting concluded with discussion of the Geodynamics and Energy Resources Map Series as well as plans for publication of data on the 1:20,000,000-scale Pacific Basin base.

The following summary outlines some of the more important discussions and conclusions that occurred during the four-day meeting.

Opening Session

At the inaugural session of the four-day Map Project meeting at the National Academy of Sciences headquarters in Washington, D.C., John A. Reinemund opened the meeting with a recapitulation of Map Project activities during the 12 months since the previous panel chairmen's meeting held in Menlo Park, California. He then called on the panel chairmen for final summary statements on the status of map compilation by their panels.

The opening remarks were followed by an hour-long congressional and press briefing in which plans for the August 1982 Circum-Pacific Conference on Energy and Mineral Resources, Circum-Pacific Map Project activities, and U.S. Geological Survey programs in the Pacific region were presented (figure 7). Outlining the work of the Circum-Pacific Map Project, U.S. Geological Survey Director Dallas L. Peck (figure 8) called attention to the already published maps on exhibit, observing that the maps benefit the countries and people of the Pacific region by aiding in "the search for critically needed mineral and energy resources. Results that will increase the understanding and help decrease the pain and suffering from natural hazards such as earthquakes and volcanoes." Peck said that the Geological Survey has more than 100 projects underway in the Pacific Basin region, and he outlined cooperative efforts in South America, Southeast Asia, and China.

Figure 6. Participants in the Circum-Pacific Map Project meeting, U.S. Geological Survey National Headquarters, Reston, Virginia, May 11, 1982.

Figure 7. William W. Hutchinson, Canadian Department of Energy, Mines, and Resources (left), J. Erick Mack, Jr., General Chairman, Circum-Pacific Conference, Dallas L. Peck, Director, U.S. Geological Survey, and John A. Reinemund, Director, Circum-Pacific Map Project (at podium), appear before a congressional and press briefing on Circum-Pacific Council and Map Project activities at the National Academy of Sciences, Washington, D.C., May 10, 1982.

Map Project Director John A. Reinemund (figure 7) pointed out the newly published 1:20,000,000-scale Pacific Basin Map, noting that the Holocene volcano and seismic epicenter data sets provided information of interest beyond the community of earth scientists. He observed that severe earthquakes, those with magnitudes of 7.5 or greater, are shown by year of occurrence and a special symbol, and that volcanoes active during the period 1964-1980 are also distinguished. Reinemund also drew attention to a newly completed proof of the Northeast Quadrant Mineral Resources Map showing land mineral deposits with a special symbology developed by Philip W. Guild, and sea-floor-mineral resources, including manganese nodule occurrence and chemical composition, by David Z. Piper and Vincent E. McKelvey.

Also addressing the 22 representatives from the news media in attendance were J. Erick Mack, Jr. (figure 7), General Chairman of the Third Circum-Pacific Conference, on plans for the forthcoming international meeting, and William W. Hutchison (figure 7), Assistant Deputy Minister for Earth Sciences, Department of Energy, Mines, and Resources, of Canada, on a special petroleum resources assessment symposium to be held in Honolulu, Hawaii, August 20-22, 1982, preceding the Circum-Pacific Conference. The morning session closed with an informal question and answer session between the speakers, Circum-Pacific Map Committee members, and the media representatives.

Figure 8. Dallas L. Peck (left), Director, U.S. Geological Survey, being interviewed by Peter Blau, Petroleum Information Service, following a congressional and press briefing held at the National Academy of Sciences, May 10, 1982.

Report from the Map Series Publisher

At the second day's session, which convened at the U.S. Geological Survey's National Center in Reston, Virginia (figure 6), Ronald L. Hart, representing the AAPG, announced that map sales during the 12 months ending in April 1982 had been unusually brisk. More than 4,000 map sheets were sold, including more than 1,000 Northeast Quadrant Map sheets. Sales of the Geographic and Base Map Series during the year rose sharply, with more maps being sold than during the previous four years. Hart, Projects Manager for AAPG, attributed the pickup in map sales to a large promotional mailing of the Map Project brochure, which was sent to members of the AAPG, Geological Society of America, and Society of Exploration Geophysicists in March. He also noted the distribution by Map Project headquarters of an informational brochure in Spanish to Latin American countries which has publicized the availability of the three published map series. A resume of map sales as of June 30, 1982, is shown in table 6.

Hart went on to say that the Plate-Tectonic Series will be made available in a six-map package together with an explanatory booklet by George W. Moore (1982) later this year. The maps are being marketed in Europe by an official distributor in London and negotiations are underway for an agent in Japan for the western Pacific region. In this connection, consideration is being given to issuing an informational brochure on the Map Project and the Plate-Tectonic Map Series in the Japanese language. Chikao Nishiwaki, Northwest Quadrant Panel Chairman, stressed the potential appeal of the Plate-Tectonic Maps to professional geologists and university students in Japan and also what he sees as a large market at the high school level. In this connection he mentioned a five-part Japanese television series on the ring of fire and plate-tectonics for which he is serving as scientific consultant. The series was scheduled to be shown in Japan late this summer and could serve to stimulate interest in this map series, according to Nishiwaki.

In response to questioning, Hart indicated that complete sets of folded maps would be available for purchase at the AAPG booth at the Circum-Pacific Conference in Hawaii and at AAPG displays at subsequent meetings. He said, however, that it would be preferable if the Map Project continues to maintain a separate exhibit of the maps at major meetings in the United States and that, if necessary, AAPG would arrange for the exhibit space. Hart said that space in the AAPG exhibit area was not sufficient for displaying the maps. He noted that normally AAPG does not display their publications at international meetings other than at the Circum-Pacific Conferences. With regard to distributing maps in non-English-speaking countries, Hart said that AAPG would be willing to look at the possibility of printing special foreign language editions, specifically Japanese and Spanish, with the map legends and explanatory text materials printed in the particular language.

Map Project Publicity

Warren Addicott outlined headquarters' efforts to distribute the 10,000 copies of the trifolded Map Project brochure that were printed in November 1981. He said that to date more than half of these copies had been distributed. He also reported that displays had been staged at the AAPG national meeting in San Francisco in June 1981, at the Geological Society of America annual meeting in Cincinnati in November 1981, at the American Geophysical Union meeting in San Francisco in December 1981, and at the Geological Society of America Cordilleran Section Meeting in Anaheim in April 1982. Plans to exhibit the maps at the 1982 AAPG meeting in Calgary and at the 1982 Geological Society of America meeting in New Orleans were discussed and approved by the Map Committee. José Corvalán recommended that the Circum-Pacific maps be exhibited at the Third Chilean Geological Congress in Concepción in November 1982 and indicated that he would look into ways and means of doing so. Newspaper, magazine, and journal articles (Doutch, 1981b; Addicott, 1981a, 1981b, 1981c; Hoover, 1982; Eister, 1982) about Map Project activities published since the last meeting were displayed by the project headquarters staff.

Report from the Circum-Pacific Council

J. Erick Mack, Jr., Vice-Chairman of the Circum-Pacific Council and General Chairman of the Third Circum-Pacific Conference on Energy and Mineral Resources, outlined plans and the tentative program of papers for the Third Circum-Pacific Conference in Honolulu, Hawaii, August 23-27, 1982. The theme of the conference is Energy for the Eighties. The Map Project, according to Mack, would have a major contributing role in the scientific sessions and also in the exhibits area where the published maps were to be prominently displayed. It was decided that the Map Project would hold a special interim meeting in Honolulu on August 22 and 23 in conjunction with the Circum-Pacific Conference. Mack also mentioned that plans were being made for the incorporation of the Circum-Pacific Council as an international section of the AAPG and that this action would be acted on during the Honolulu meeting.

Report on the Commission for the Geologic Map of the World

Frances Delany, Secretary General of the Commission for the Geologic Map of the World (CGMW), commented on the speed with which the Circum-Pacific maps are being completed. She noted that, although the Map Project is only about nine years old, many individual CGMW maps take 10 years to complete and publish and some a good deal longer. Areas of joint interest to CGMW and the Map Project are in South and East Asia and South America. The CGMW tectonic maps of South and East Asia and of Africa, now being compiled, will show geology of the offshore areas. A recent change in policy has led to consideration of including sea-floor sediment on the CGMW map of Africa.

Delany advised the group that the recently published General Bathymetric Chart of the Oceans (GEBCO) sheets are being digitized, together with certain updating of bathymetric contours, by a U.S. governmental agency. She recommended that these be consulted if an effort is made to update the basic bathymetric contouring on the Circum-Pacific maps.

A new CGMW endeavor of interest to the Map Project is a proposed energy resources map of South America which was to be considered at the Second Brazilian Petroleum Congress in Rio de Janeiro in September 1982. Also, a color proof of the new CGMW metallogenic map of South America was scheduled to be completed at about that time.

Delany noted an apparent duplication of effort in Southeast Asia where the Circum-Pacific Mineral Resources Map will very likely overlap with the CGMW metallogenic map of south and east Asia at a scale of 1:5,000,000. She also noted that there will be a United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) mineral resources map of this general region. There will be, however, considerable differences in the geologic or tectonic background of the maps, according to Delany.

Reinemund expressed his view that the CGMW should take on an overriding role of coordinator in the planning of regional mapping efforts so as to avoid possible duplication of work. Noting the affiliation of the CGMW with the International Union of Geological Sciences (IUGS), he said that the parent body should look into ways and means of strengthening CGMW so that it could fulfill such a role. Reinemund pointed out the fundamental difference in orientation of CGMW projects and the Circum-Pacific Map Project, the first being primarily continent-oriented and the second based around an ocean. He suggested that the present more or less ad hoc nature of the CGMW projects would be strengthened by developing a continuing mechanism for map compilation such as has been established with the Circum-Pacific Map Committee.

Delany responded, noting that until 1980, when the statutes were changed, CGMW's efforts were limited to making geologic maps and that their statutory members are still geological surveys, not oceanographic institutions. Nevertheless, she said that CGMW, being a nongovernmental organization with a strong international representation, has an enormous advantage in trying to coordinate international mapping projects. As such, she maintained that it wouldn't be unreasonable for CGMW to attempt to coordinate a circum-Atlantic or circum-Indian Ocean project.

Philip W. Guild reviewed CGMW efforts in Europe, North America, and South America, pointing out that the CGMW has been a catalyst in bringing together cooperative projects, in particular in South America. Douglas M. Kinney told the group that the Circum-Pacific work was closely coordinated with CGMW efforts from the start, as he initially served as vice-chairman of the Map Project and was also intimately involved with CGMW work at the same time.

Plate-Tectonic Map Series

Discussion chairman Warren O. Addicott noted that the 1:20,000,000-scale Pacific Basin Plate-Tectonic Map had been printed a few days prior to the meeting, completing the six-map series. George W. Moore presented his manuscript for the accompanying explanatory booklet, noting that the basic premise was to put forward a fairly simple statement that outlines the evolution of plate-tectonic theory. The underlying approach, he said, was historical, with each major new idea relating to plate-tectonic theory being introduced in sequence. Moore emphasized that there are many explanations of plate-tectonics in print--entire books, and chapters in many textbooks--and that the purpose of this text is to directly accompany the maps, and serve as a means of explaining concepts. He recommended that the booklet be issued with individual maps or the entire set at no added cost.

Consideration of the manuscript included suggestions for extensive discussion of earthquake and volcano data sets and a section devoted to these and the other active features depicted on the maps. Other suggestions were to include a statement of problem areas and further consideration of data points utilized in the Minster and Jordan (1978) plate-motion analysis.

It was decided to allow 10 days for further review of the manuscript and then to move ahead with completion and printing so as to have it ready in time for the Third Circum-Pacific Conference on Energy and Mineral Resources in August 1982. Doutch suggested that the initial printing be considered preliminary so as to allow more time for review by the panels. Mack called for a printing of 3,000 copies.

Nishiwaki indicated his interest in translating at least the introductory parts of the booklet into Japanese and to include this translation with maps sold in Japan. He said that it would be relatively easy to then translate it into Chinese. Hart questioned whether it might not be beneficial to do the entire booklet in Japanese as well as in Spanish. Addicott suggested that if this were done, it would be useful to include translations of the explanatory materials in the map margins.

McKelvey called for a distinction in the text between continental and oceanic crust, even though this is not directly shown on the Plate-Tectonic Maps. His view was that identification and differentiation of oceanic ridges composed of oceanic crust as opposed to continental margins would eventually prove useful with regard to the Law of the Sea Treaty that had just been finalized (McKelvey, 1982). This could be handled, he said, in a section in the booklet dealing specifically with the Circum-Pacific region.

Geologic Map Series

Addicott, discussion chairman for this session, announced that a preliminary proof of the Geologic Map of the Southeast Quadrant, made only days before the meeting, was incomplete. The color process films, made by an outside contractor, were completed under a severe time constraint that did not allow checking and, consequently, some of the colors were inaccurate. Film positives of the final linework and map margin material for the Northeast and Southeast Quadrant sheets, together with color guides, were posted for study and discussion by the committee.

Early in 1982 it was decided to abandon the original plan of making final hand-colored copy for preparation of color negatives (Richards, 1979, p. 9) in favor of computerized scanning of color-coded map units to obtain color separations. The change in plans was made in order to permit updating and author corrections and to allow computer-assisted printing of map units onto other scales or projections.

Addicott announced that mapping of sea-floor sediment by Floyd W. McCoy of Lamont-Doherty Geological Observatory has been completed for three of the five map sheets: the Northeast, Southeast, and Northwest Quadrants. The final two sheets, Antarctica Region and Southwest Quadrant were expected to be completed before the Interim Meeting in August 1982.

McCoy, who was unable to attend the meeting, submitted a proposal to the Map Committee that the sediment data be generalized and issued on the 1:20,000,000-scale base as a separate map in the Pacific Basin Series. Discussion of McCoy's proposal brought out suggestions that the sea-floor sediment be combined with sea-floor mineral-resources data that have been already compiled on the 1:20,000,000-scale base by David Z. Piper and Theresa R. Swint. Corvalán and others expressed the view that the 1:20,000,000-scale maps should follow, very closely, the format of the basic thematic map series and that it would be inadvisable to issue a sediment map without accompanying land geology, following the format of the 1:10,000,000-scale map series.

Reinemund questioned the cartographic representation of sea-floor sediment by color fields, noting that the uniform color implied well-defined distributional patterns while, in some areas, the data are very sparse, and the map units relatively speculative. Reinemund also brought out the potential problem of showing the geology of the shelf together with the colored sea-floor-sediment categories.

Doutch suggested that solid colors be reserved for the geologic units on the shelf and that colored patterns be used for the sea-floor sediment. He argued that the surficial-sediment data were of less significance in terms of Map Project goals than depiction of shelf geologic units. He pointed to the substantial shelf areas in the Southwest Quadrant, particularly in the overlap area with the Northwest Quadrant.

Addicott then outlined the series of cartographic experiments undertaken by project headquarters to evaluate different ways of depicting the sea-floor-sediment units, data points, and other sea-floor data. He reviewed the succession of small-area experimental color proofs of part of the Northeast Quadrant Map that were made for Map Committee study and evaluation. The final decision to use pale colors for the 12 sediment units was based, he said, upon the final experimental proof that was circulated to the panel chairmen in late 1981. Subsea bedrock geology, Addicott noted, was being shown on the Northeast Quadrant Map by point data compiled by George W. Moore.

Doutch said that on the Southwest Quadrant Map he wanted to show the same kind of stratotectonic units on the sea floor that were to be shown on land, by colored sediment patterns superimposed upon these colored units. These units, for the shelf, would reflect the geologic event that resulted in the particular stratigraphic package. Doutch said he would prefer to use five units for packets of sediment associated with five different episodes of the breakup of Gondwanaland, but that, at present, these were all lumped into one Quaternary-Jurassic unit. Corvalán expressed his view that these units should be shown on the Tectonic Map, because he felt that they are not as objective as the land geologic units.

Drummond answered that he was satisfied with the format and use of colors for sea-floor sediment on the Southeast and Northeast Quadrant map sheets. He noted that if shelf geology were to be shown in color on the Northeast Quadrant he would have to leave almost all of the shelf white as only three small areas are well enough known geologically to show map units. Depiction of the surface sediment, Drummond said, is a better alternative for the marine parts of the Northeast Quadrant. His view was that an optimal way of showing the shelf geology would be by isopachs that are to be included on the Tectonic Map.

Craddock questioned whether the use of isopachs on the Tectonic Map could adequately depict the five different sedimentary sequences, all having different histories, surrounding the Australian continent. Regardless of whether the shelf was left white or filled with colors for sediment units, it was critically important, Craddock said, to be able to differentiate between the two kinds of information: a geologic map on land and a surficial sediment, or "soils" map, on the sea floor.

Others expressed their support of either patterns or solid color for the sea-floor sediment.

Corvalán said that for the Southeast Quadrant there are very few geologic data for the shelf area and that these sparse data could, at best, provide a very patchy pattern of outcrop. His recommendation was to show the sediment cover that overlies bedrock.

Nishiwaki reviewed the problems of mapping shelf geology in the Northwest Quadrant region, noting that in the marginal seas there is a thick marine sedimentary cover and that preliminary efforts to draw a map of the shelf geology at 1:10,000,000 scale were unsuccessful. He concluded that it was preferable to show surficial-sediment distribution on the shelf areas.

Reinemund then summarized the discussion on sea-floor sediment and proposed that the model developed for both the Northeast and Southeast Quadrants be adopted with bathymetric contours sufficing to show the extent of the continental shelves. Depiction of shelf geology, he proposed, could be shown on a separate inset map or in the accompanying booklet, according to the panel chairman's wishes. This proposal met with the unanimous agreement of the five panel chairmen.

In response to a call for the status of compilation of the Southwest Quadrant Map, Doutch announced that a final compilation would be completed prior to the Interim Meeting in late August. His work on the text for the accompanying booklet will take somewhat longer. For this document Doutch proposed to discuss the geology country by country so as to make it easiest to use. This, he pointed out, would depart from Corvalán and others' model for the Southeast Quadrant that is based upon the geology of the Andean chain.

Reinemund then said that there should be sufficient latitude in preparation of the accompanying pamphlets to allow special treatment for the map sheets as required by the particular geologic domains in individual quadrants.

For the Northwest Quadrant, Nishiwaki pointed out that a geologic map compilation was first completed in 1977 but became slowly out-of-date during the ensuing five years while the sea-floor-sediment work was brought to a conclusion. As a consequence, it has been necessary to initiate a thoroughgoing revision and recompilation of the map. This work is now underway under the supervision of Deputy Panel Chairman Tamotsu Nozawa, who is being assisted by Professor Tadashi Sato of Tsukuba University and by Yoji Teraoka, Konosuki Sawamura, and Takashi Yoshida, all of the Geological Survey of Japan.

Nishiwaki mentioned problem areas, such as China, Laos, Vietnam, and parts of Indonesia, where it has been very difficult to secure adequate mapping. The compilation of the Tectonic Map will go on concurrently with the Geologic Map and should be completed just a few months later. It is expected that work on the Geologic Map will be completed by the end of 1982 and that final compilation copy can be sent to project headquarters early in January 1983.

It was noted by Frances Delany that a new geologic map compilation for South and East Asia has been completed for the CGMW. Terman suggested that a copy of this map be obtained and made available to the Northwest Panel, provided that Delany was in agreement. Session chairman Kinney asked Terman to follow up on his proposal and, if possible, to secure a copy for the Northwest Panel.

Craddock summarized the status of compilation of the Antarctica Sheet, noting that a final map had been completed for the Antarctic Peninsula area. Mapping of West Antarctica has been completed and within two weeks or so the entire map will be finished. Craddock predicted that the compilation would be ready to send to the panel members for review toward the end of summer.

In response to a question by Guild on editing of the completed map compilations, Addicott replied that this effort would be carried out by project headquarters in Menlo Park in cooperation with the panel chairmen. Doutch pointed out that for the Southwest Quadrant, the map will have gone through a fairly rigorous check by the map-editing section of the Bureau of Mineral Resources in Canberra. Addicott added that each map will also go through an editing procedure within the Technical Reports Unit of the U.S. Geological Survey.

Minerals Map Series

Discussion chairman McKelvey announced that the first proof of the Northeast Quadrant Mineral Resources Map incorporating sea-floor-minerals data had been completed only days before the meeting began. About 2,500 land-mineral deposits now are depicted on the map, according to Guild. He noted a very close correspondence to the recently published 1:5,000,000-scale CGMW metallogenic map of North America (North American Metallogenic Map Committee, 1981; Guild, 1981), and that the smaller symbols utilized on the Northeast Quadrant Map allowed inclusion of essentially all the information shown on the larger-scale map.

Guild specifically asked the panel chairmen for their approval of the Northeast Quadrant Map format and symbology (table 7) as a general model for the other maps in this series. He recommended to the panel chairmen that a geologic background taken from the Geologic Map Series be used on all of the Minerals Maps, rather than the modified tectonic interpretation that was independently developed for earlier proofs of the land areas on the Northeast Quadrant Map. Much of the delay in completing this map, he noted, was in waiting for land geology from the Northeast Quadrant Geologic Map which had been finalized only a few weeks earlier.

Guild also expressed his desire to depict accreted terranes on the Northeast Quadrant Minerals Map, but said that the full 200 or so presently recognized terranes was too complex a scheme to include on the already burdened map. Showing the innermost extent of accreted terranes, as was done on the Plate-Tectonic Map of the Northeast Quadrant (Drummond, 1981), was feasible, in his view. This question was passed on to the panel chairmen for their consideration.

David Z. Piper, principal author of the marine-minerals element of the Minerals Resources Map Series, reviewed the compilation of manganese nodule data that began almost two years earlier. Nodule-abundance values determined from bottom photography were plotted, together with gravity-core and box-core data. The data were then contoured. Piper noted that nodule distribution tends to be spotty but that in the high-abundance areas--greater than 50 percent of the sea floor covered by nodules--a very high percentage of the cores also recovered nodules.

Piper reviewed the recently made decision to include a generalized depiction of McCoy's (1981, 1982) sea-floor-sediment map units that were developed for the Geologic Map Series. He noted that almost all of the significant nodule occurrences fall outside of areas of carbonate sediment on the Northeast Quadrant Map.

The sea-floor-nodule map compilation, according to Piper and his colleague, Theresa R. Swint, is nearly completed, with only part of the Northwest Quadrant remaining to be finalized. Piper summarized the findings on a generalized map of the entire basin, pointing out areas of unusually high nodule concentration that were largely confined to the northeastern Pacific region, particularly the southern part.

Other parameters shown on the sea floor are phosphate deposits provided by Burnett and Lee (1980) and massive sulfide deposits associated with hydrothermal vents along actively spreading ridge crests on the East Pacific Rise. Manganese nodule chemistry data and contouring were provided by McKelvey. In response to a question by Guild on metalliferous mud, Piper said that although present the largely iron- and aluminum-rich muds are low grade and, in his opinion, should not be shown on these maps.

Craddock advised that use of colors on the proof should be altered so as to provide a greater contrast between the colors used for background geology on land and the sea-floor-sediment colors. This would provide a clear demarcation between land and sea areas, which he felt was highly desirable.

Doutch suggested that it would be helpful to introduce age coloration in the geologic background so as to deal most effectively with the Precambrian in Australia, which includes the major ore deposits of that continent. Guild responded that he is now looking at utilization of age colors directly from the Geologic Map Series together with the symbology from the Geologic Maps. He added that, in some cases, different ages might be lumped under a single color, with the symbols denoting the basic age categories.

For the Southeast Quadrant Map, José Corvalán indicated his preference for taking the units from the Geologic Map together with significant structural elements. He said that units significant for mineral deposits should be emphasized and those that are not significant might be lumped together under fewer colors, such as the two Paleozoic units on the Southeast Quadrant Map. In response to questioning by Doutch, he said that certain kinds of covering rocks should be retained as individual units, as in the case of late Tertiary and Quaternary volcanic cover in Peru, Bolivia, and Chile that in all probability conceals ore deposits.

Nishiwaki discussed problems in obtaining mineral-deposit information for the Northwest Quadrant Map from Asian countries. Recently, however, communication has improved to the point that assembling a detailed map is now a distinct possibility. It will, however, require appreciable travel on the part of the map compilers in order to obtain important unpublished data. Nishiwaki said he plans to depict both active and inactive plate boundaries on the Northwest Quadrant Map because there is a close genetic relationship of many ore bodies to the subduction process. He also expressed the view that depiction of maximum horizontal stress directions would be a useful addition to the map. Once the Geologic Map of the Northwest Quadrant is completed, it could take almost one year to finish the Minerals Map.

Doutch agreed with Nishiwaki's view with respect to showing these features on the Southwest Quadrant Map. Guild responded that subduction zones had not been depicted on the Northeast Map up to this point. He said that there was no reason why it could not be done, but held that this parameter was better shown on the 1:20,000,000-scale base map. McKelvey suggested that addition of the subduction zones would not unduly complicate the Northeast Map, and Drummond agreed, saying that inclusion of these features would tend to tie together tectonic features, such as the spreading centers and transform faults--for example, the San Andreas fault--which are already shown on the map.

It was agreed, finally, that the subduction zones would be shown on the Northeast Map as well as on all subsequent maps in the series.

Doutch suggested that platform cover could be differentiated from cratonic outcrop cartographically by placing a border line around a sedimentary basin or by a gray color screen over basement so as to distinguish between the two types of terrane. In a number of areas, for example, Archean basement rocks contain one kind of ore deposit, whereas overlying Proterozoic basin rocks contain a different kind of ore deposit. His view was that the present map content, although coming close to a metallogenic map, could be called a minerals-environment map. Guild responded that in his view the symbology developed by the project to indicate age of mineralization could adequately show stratabound ore deposits as to age.

McKelvey next brought up the question of depicting accretionary terranes, noting that including this parameter would likely bring too great a degree of complexity to the maps. Doutch responded that if these terranes were depicted in the same way as on the Plate-Tectonic Map, perhaps as simple crosshatching for the areas of accretionary terrane, it would not unduly complicate the maps. Corvalán said that accretionary terranes should not be depicted on this map series owing to their highly interpretive nature and the agreement, already reached, that the geologic background should come directly from the Geologic Map Series.

Guild responded that, although it had not been attempted so far, the map compilers were ready to place a simple red line on the Northeast Mineral Resources Map to indicate the innermost occurrence of accretionary terrane. He said, though, that he had many reservations about the significance of such a line. McKelvey responded, saying that he felt that it probably was best not to include depiction of accretionary terrane on the Minerals Map, but to consider it for a second-generation interpretive map. Addicott pointed out that two groups in Menlo Park are independently making terrane maps of the Northeast Quadrant and the Pacific Basin, respectively, but that the effort is not directed at inclusion of these interpretations on any of the already scheduled maps.

McKelvey voiced the opinion that it would be very useful to prepare a circular to accompany each of the maps, such as perhaps a gazeteer of the deposits. Guild pointed out that a computer listing of ore deposits for the area from Central America to Alaska has been prepared and is being updated as additional data become available. Nevertheless, the list is now rather obsolete, and future updating and additions to it must await completion of the Minerals Map, owing to lack of time to complete the listings. Guild felt that a booklet, if issued, should come out following completion of the Minerals Map Series and not with each individual map.

Doutch favored publishing a booklet as a means of complementing the map with additional information, this assuming that the map explanations might not fully explain the maps.

Guild said that he was still undecided as to whether to use lithologic overprints directly from the Geologic Map of the Northeast Quadrant or to develop alternatives.

Reinemund summarized the discussion of the Northeast Quadrant color proof and asked how much more effort would be needed to perfect the depiction of sea-floor-mineral data, abundance contours, sea-floor sediment, and bathymetry. Piper pointed out the basic problems with depiction of the sea-floor minerals. Michael P. Lee suggested that a series of proofs showing alternative ways of depicting sea-floor information be made for further consideration at the 1982 Interim Meeting.

It was agreed that plans to publish this first map in the Mineral Resources Series would not be formalized until the panel chairmen had had an opportunity to see further experimental proofs dealing with the sea-floor-minerals element.

It was also decided that a report to accompany the Mineral Resources Map Series should be issued with the entire set of completed maps. Consideration of its form and potential content was deferred. Finally, McKelvey asked each panel chairman to forecast the completion of a high-quality compilation draft of the Minerals Map for his quadrant.

Doutch estimated that information on some 600 mineral deposits needs to be collected and put onto data sheets and computerized before the Southwest Quadrant Map can be compiled. Drafting assistance has been a continuing problem in Southwest Quadrant work, but nevertheless, he estimated that a completed but not necessarily high-quality draft could be assembled by the time of the 1983 panel chairmen's meeting.

Corvalán pointed out that a compilation has already been completed for the Southeast Quadrant but that selection of significant geologic units from the Geologic Map of the Southeast Quadrant and simplification of these units needs to be done. He said that this could be accomplished with the help of a draftsman in time for presentation at the August 1982 meeting in Honolulu. Also remaining to be completed on the map is placement of the small ticks that indicate age of formation of the mineral deposits. This will take longer to complete. Guild noted that additional sources of mineral-deposit data had recently been published and should be taken into consideration in updating the Southeast Quadrant compilation.

Nishiwaki indicated that the Northwest Quadrant Minerals Map could be completed by August 1982, with the exception of information on China and the Soviet Union, which will take longer to finalize. Guild advised Nishiwaki that representatives from both of these countries were expected to attend the Honolulu meeting in August, and that action to complete those parts of the map might be taken at that time.

Craddock said that a preliminary effort toward compiling a mineral-deposit map of the Antarctic region had been carried out by the previous panel chairman, F. Alton Wade, and that no additional work had been undertaken since that time. He said that work on the map will be resumed and that the compilation will be well advanced toward completion within a year.

Sea-floor-minerals mapping had been completed for all of the map sheets excepting the Northwest Quadrant, according to Piper, Swint, and McKelvey. All the available data had been plotted for the northwest Pacific, but they were not as amenable to contouring as were the data of the other parts of the Pacific, according to Piper and Swint. The basic mapping will be completed and ready for cartography before the next yearly meeting.

Reinemund asked McKelvey to prepare a summary report of this session and also to come up with a plan for a report to accompany the Mineral Resources Map Series. McKelvey concurred, saying that it would be advisable for each panel chairman to prepare a report discussing his quadrant at the time the map is completed, and that these could eventually be consolidated into one report. Craddock agreed that this would be a useful effort. The plan, completed following the meeting, is shown in table 8.

Tectonic Map Series

Discussion chairman Maurice J. Terman opened the session with a recapitulation of the agreements reached during the May 1981 panel chairmen's meeting in Menlo Park, California: "Jim Case chaired an extensive and thorough review of the current compilation guidelines and potential alternatives. This discussion was continued by a selected panel during an _ad hoc_ evening session and then reviewed by the panel chairmen in still another separate session. These consultations focused on the basic choices for the use of color on the Tectonic Map, either to show full system deformation ages, or significant tectonotypes or facies, regardless of age. The panel chairmen chose the former alternative and will generally continue to use the current guidelines, which show distribution of major rock types by color for age of deformation, metamorphism, or magnetism in the basement rocks, and for the age of sedimentation or volcanism in the covering rocks. No specific changes were suggested for structural tectonic features. Important new guidelines will be formulated for passive-margin tectonic features, for accreted or suspect terranes, for tectonic stages in creation of oceanic crust, and for major crustal types."

A redrafted compilation guide (see table 9) was assembled by Terman, following discussions at the Southwest and Northwest Panel meetings in late 1981.

Terman noted that a group of gravity experts had been convened in Reston during February 1982 to consider the gravity element of the Geodynamics Map Series. The recommendations of this group were distributed to the committee. Basically, they called for removal of many of the parameters on the Geodynamics Map to the Tectonic Map so that the Geodynamics Map would be essentially a gravity-anomaly map. This report formed the basis for subsequent discussion of the Geodynamics Map Series and part of the discussion on the Tectonic Map Series.

Upon Nishiwaki's suggestion, a point-by-point review of parameters for the Tectonic Map Series based on attachment 12 from the 1980 meeting (Addicott, 1980, p. 51-52) was undertaken.

Terman brought out the recommendation of the gravity panel to depict fault activity on the Tectonic Map rather than the Geodynamics Map. Thus, faults would now be classified according to three categories on the Tectonic Map: historic (red), post-Miocene (orange), and pre-Pliocene (black). In response to a question from Nishiwaki, Terman noted that this classification was influenced by the adoption of the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI) (1973) volcano data set for use on the Circum-Pacific Maps (Richards, 1979). The time frame and the color scheme for these two data sets were designed to be parallel. Inclusion of active faults on the Tectonic Maps and the three-fold classification were approved by the panel chairmen.

Another element that was suggested for transfer from the Geodynamics Map to the Tectonic Maps by the gravity panel was lineaments. Terman noted that Douglas Carter of the U.S. Geological Survey had records of all known lineament studies in the world. He also said that compilation of this information would not be the responsibility of the panel chairmen. It was generally agreed that lineaments are more suitably included in the Tectonic rather than the Geodynamics Map Series.

Douglas Carter presented a brief summary of lineament mapping by the U.S. Geological Survey in the Pacific region. For the Northeast Quadrant, there are reasonably good mosaics of Alaska, Canada, the United States, Mexico, Central America (excluding Panama), Colombia, and Venezuela. A project now underway in Ecuador should produce a map within a year or so. Each country has produced a first- or second-generation study, but there are some problems in drawing the information together, especially with differing projections.

Carter noted that a new project called the North American Plate Mosaic is getting underway as a part of the Geological Society of America's Centennial Project. The plan is to produce an all-digital color mosaic, or series of mosaics, ranging from 1:250,000-scale maps up to a 1:5,000,000-scale mosaic of the entire North American Plate.

In the Southeast Quadrant, lineament maps have recently been completed by Bolivia and Brazil. There is good coverage of the northern two-thirds of Chile, but the status of mapping of Argentina is unknown.

Coverage for the Northwest Quadrant is good. Japan has completed a lineament map. In 1979, a lineament map incorporating interesting new symbology was produced in the Soviet Union. Carter said he was recently in China, where he found that lineament studies similar to the Soviet Union study are underway.

Information for the Southwest Quadrant is more limited, according to Carter. Both Indonesia and Thailand have been working on lineament maps for some time. Australia and New Zealand have also been very active in this field of study. The status of mapping in other parts of southeast Asia, however, is not known.

Earthquake focal mechanisms and state of horizontal stress, elements also recommended by the special panel for transfer from the Geodynamics Map to other maps, were considered by the panel chairmen to be inappropriate for the Tectonic Map, and are best retained on the Geodynamics Map Series. Some consideration was given to placing these two elements on a transparent overlay so as to be able to compare them with the Mineral Resources Map and other Circum-Pacific maps. Nishiwaki expressed his concern over the space taken up by the beachball symbols which would conceal other data. He also made a plea for showing only *in situ* stress measurements.

Tom Simkin of the Smithsonian Institution discussed compilation of volcano data for the Tectonic Map Series. He indicated that, since completion of the basic Holocene volcano data set (Simkin and others, 1981) depicted on the Plate-Tectonic Map Series, an effort has been mounted to extend the time range of the set so as to include post-Miocene volcanic centers. In so doing the file has been expanded from some 1,400 Holocene volcanoes to close to 3,000 post-Miocene volcanic centers. At present these data are on some 300 work sheets but have not been entered into the computer.

Simkin noted that the IAVCEI post-Miocene volcano file (IAVCEI, 1973 [1975]) was begun during the 1960's, the first data sheets being published in 1975. The information in some areas is not entirely current and the extent of coverage, worldwide, tends to be uneven, he said. There are some areas in which compilations have not been completed by the IAVCEI.

Three sources of data in addition to the IAVCEI file have been utilized in the Smithsonian compilation; one of these is for mainland Asia, another is for the Urals and Kamchatka. Nevertheless, there are gaps in coverage and the quality of coverage is extremely varied. The most serious gaps for the Circum-Pacific Project area, he said, were in the Indian Ocean and in the Southwest Pacific. Additional effort in western North America would be needed, in his opinion, to bring the IAVCEI compilation for that region up to date.

The Smithsonian file does not contain chemical analyses, although an attempt is being made to include lithologic categorization for products of individual volcanoes. Simkin's view was that it would be very difficult to categorize volcanoes as either andesitic or basaltic from these records.

The Smithsonian Holocene volcano data file, which was printed on the Plate-Tectonic Map Series, is being continually updated. At least 150 new eruptions have been added since publication of the original report nearly eight months ago (Simkin and others, 1981). A supplement to that report will be issued on an annual basis. It will follow the same format but will only include new or revised information, and will thus be quite small.

Terman recommended that a revised compilation guide for the post-Miocene volcanoes be developed by the Map Committee in consultation with Simkin.

Paul W. Richards suggested that depiction of salt domes be changed from showing individual domes to indicating areas in which many salt domes occur by using a pattern and boundary line. Drummond agreed with this approach and it was approved by the panel chairmen.

The symbology suggested for cryptoexplosion structures was considered and approved, although varying concepts of what this category includes made it clear that each panel will have to specify what is being included under the symbol on their map.

Discussion of the depiction of geochronologic ages was carried by Nishiwaki who indicated that the Northwest Panel had a number of radiometric age determinations from seamounts. He questioned, however, what symbology was to be used, noting that this has not as yet been included in the compilation guidelines. Terman proposed that each age date be accompanied by a parenthetical indication of how it was derived. Further discussion led to an agreement that ages shown in this manner would be strictly radiometrically determined. It was noted that paleontologic ages are being shown, in a general way, by the Deep Sea Drilling Project (DSDP) columns on the Geologic Map sheets (Swint and Richards, 1983).

Terman next brought up depiction of paleomagnetic data, observing that the intent of incorporating this parameter was to attempt to show the transportation of terranes significant distances. Nishiwaki and Tamotsu Nozawa, of the Northwest Quadrant Panel, said that they had data for the Japanese Islands, but needed more to fill out the Northwest Quadrant Map. Terman announced that a synthesis of data for all of southeast Asia was in press and would soon be available from the Committee for Coordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas (CCOP).

Moore observed that this was one of the most active fields in geology today and that perhaps by the time the maps were ready for printing there would be sufficient information available to permit selection of an arbitrary time for all of the readings to be used. He suggested the Miocene Epoch, and that the Miocene latitude be expressed as a plus or minus of the present latitude of the station. Doutch agreed to check with M. W. McElhinny about data availability for the Australian continent.

Compilation of sediment isopachs for oceanic areas, principally from Ludwig and Houtz (1978), has been completed for the entire region, with the exception of the southwestern part of the Southwest Quadrant and the Antarctica Region south of latitude 67° S., according to Addicott.

Referring to the United Nations Conference on the Law of the Sea (UNCLOS), McKelvey pointed out that the foot of the continental slope plays an important part in determination of the extent of national jurisdiction, and he asked if the map would include a line marking this feature. Moore responded that at one time a line delimiting the extent of oceanic crust was to be included on the Plate-Tectonic Map, and that this line was not drawn at the base of the continental slope but close to halfway up the slope. Frances Delany said that on the CGMW maps an attempt is now being made to indicate the continent/ocean boundary by whatever means is best suited. Where the data are not precise, this feature will be shown by a shaded area, together with an indication of the criteria used, such as magnetic-anomaly data, seismic profiling, or the 3000-meter bathymetric contour.

Terman expressed interest on the part of the Map Committee in a report that McKelvey was preparing on the interpretation of the UNCLOS definition of the continental shelf (McKelvey, 1982). He asked, and McKelvey agreed, that a copy be made available for distribution to the committee, together with recommendations from McKelvey as to what course of action, if any, should be taken with respect to the UNCLOS position.

In the Southwest Quadrant, Doutch said that it would be difficult to place the boundary between oceanic and continental crust in some areas around the Australian continent. Responding to the suggestion that the limits of magnetic anomalies mapped by Golovchenko, Larson, and Pitman (1982) for the Map Project be utilized to show the extent of oceanic crust, Drummond said that anomalies cannot be detected in places where sediment cover is thick. Golovchenko then asked whether the line on the map was intended to indicate the last identified magnetic anomaly, or to be based on additional considerations, including quiet zones. Terman replied that this decision should be left to the authors, and that dashed or broken lines could be used in areas where the boundary was subjectively determined. He added that, in his view, the Lamont-Doherty depiction of oceanic crust could best be shown by a pattern and not bounded by a discrete line. This suggestion appeared to be generally acceptable to the panel chairmen.

Fred Doutch presented a draft compilation of the Tectonic Map of the Southwest Quadrant prepared by Erwin Scheibner of the Geological Survey of New South Wales, Australia. He also circulated a table of plate-tectonic units originally prepared by Scheibner for use in compiling the Southwest Map, but later discarded in favor of compilation units based upon the guidelines adopted in 1980 (Addicott, 1980, p. 51-52). Doutch questioned whether it was possible to produce an objective tectonic map in terms of the prescribed basement and cover rock categories because the guidelines were prepared, in part, based on plate-tectonic concepts. This matter, he held, was of importance in designing the legend for the map.

Corvalán said that he was in favor of the scheme presented for the Southwest Quadrant. He added that recognition and coloration of units should be changed, in his opinion, from the age of major deformation to the age of final deformation. Another suggestion was that geotectonic cycles should be recognized, not as cartographic units, but in the map legend.

Craddock agreed with Corvalán that the cyclic nature of deformation events should be recognized. He questioned the best means of portraying microcontinents of continental aspect such as New Zealand and New Guinea that are situated in distinctly oceanic settings. He favored the use of time as the major basis for subdivisions of the Tectonic Map, including crustal ages in the ocean basin.

Drummond said that he was in general agreement with the compilation guidelines for the Tectonic Map Series, indicating that he would put together a map on that basis. He expressed concern over use of the last stage of deformation for coloration of map units and said that he would still like to see some kind of tectonostratigraphic breakdown of sedimentary packages.

Nishiwaki indicated his acceptance of the guidelines utilized by Scheibner (1982) and Doutch in making the Southwest Quadrant compilation. He felt that they were broad enough to allow compilation of a Northwest Quadrant Map. Nishiwaki expressed concern about obtaining full and timely cooperation on compilation of the Siberian and Chinese parts of the map. Terman was asked to assist in obtaining these contributions.

McKelvey suggested that the Tectonic Map Series include depiction of accreted terranes, an element that was rejected for the Mineral Resources Map Series. His recommendation was that they be shown as belts rather than individual blocks. Terman replied that this element had inadvertently been omitted from the recently revised compilation guidelines.

In response to a series of questions on definitions of plate-tectonic terminology prepared by Doutch and Terman at the SOPAC meeting in September 1981 (table 6), Terman recommended to the panel chairmen that the principal terranes be shown on a small-scale inset map. Doutch objected to the use of what he considered a dual terminology for map units. Map units explained in terms of basement and cover categories, on the one hand, and plate-tectonic concepts on the other, would lead to confusion, in his view. Doutch said that if definition of the units was at all influenced by plate-tectonic concepts, even though they were basically defined on age and categorization as either basement or cover, the user would believe that all of the units had a plate-tectonic meaning, and the map would not be objective. And if this was the case, the units should be plate-tectonic units. Doutch concluded that either one criterion or the other should be used in defining the units.

Drummond agreed that there is a problem in trying to depict terranes within the currently accepted guidelines and that anything other than oceanic, continental, and intermediate terrane could not be shown on an inset map. McKelvey suggested that this problem, which involved considerable discussion, could be solved by using only oceanic terrane and continental terrane on the inset map and thereby avoid using some of the less objective plate-tectonic terminology.

A committee composed of Terman, Doutch, and Moore was appointed to formulate revised guidelines for the Tectonic Map, taking into consideration points made during the discussion and to present this in a later session of this meeting.

Reinemund summarized the Tectonic Map session, observing that a certain degree of flexibility should be allowed each panel in formulating their compilations, owing to the interpretive nature of these maps. He suggested that, if this be the case, the Tectonic Map sheets be considered somewhat experimental at 1:10,000,000 scale, and that later the basin-wide 1:20,000,000-scale map could be based on uniform guidelines. Delany agreed with Reinemund's view of allowing flexibility. She observed that one of the problems faced by the Map Project Committee was in trying to bring together two quite different parameters, age of deformation and terrane classification.

Tectonic Map Committee Report and Discussion

M. J. Terman summarized the conclusions of the three-man committee (Terman, Doutch, and Moore) that met in a brief session on Thursday, May 13, following the conclusion of the session on Tectonic Maps to finalize the compilation guidelines. Final recommendations are as follow.

Plate boundaries shown on the Plate-Tectonic Map Series will be shown also on the Tectonic Map sheets. Three categories of faults shown in three different colors, as earlier specified, were recommended, with the proviso that individual panel chairmen would also have the option of showing all faults in black. Volcano data will be taken from the IAVCEI (1973) post-Miocene volcano compilation with the recommendation that cooperation with the Smithsonian Institution be undertaken so as to update and augment this data set. A new outline for graphic portrayal of these data should be developed in consultation with Tom Simkin of the Smithsonian. Salt domes should be shown as areas of salt dome development rather than as individual features.

Terman said that an attempt will be made to compile a worldwide set of paleomagnetic determinations. Depiction of oceanic crust would follow one of two lines: 1) geologic-age units already compiled and provided to the Map Committee by Golovchenko, Larson, and Pitman, or (2) tectonic stages of spreading-pattern evolution. Terman invited the panel chairmen and the Lamont-Doherty group to evaluate the second suggestion to determine if it is feasible. Either way, these oceanic crustal units would be shown in pale colors. Intermediate colors would be used for map units depicting metamorphic, mafic volcanic, mafic intrusive, and deformed sedimentary rock, with all but deformed sedimentary rock carrying black patterning. These colors, of course, would denote age of metamorphism, magmatism, or deformation. The intermediate colors would also be used for basin deposits, which would be shown by pattern and also for platform deposits, which would be shown by colored borders. The darker colors would be used to pinpoint the magmatic belts or volcanic belts, so that felsic rocks, for example, would be depicted by a dark or bright color and black pattern.

Considerable discussion about the definition of the term felsic ensued. It was apparent that there are regional differences in usage of this term. Moore pointed out that in the United States felsic is generally used as an all-inclusive term covering rhyolite and andesite and their plutonic equivalents. He said that silicic is a more restrictive term used just for rhyolites and equivalents. Elsewhere the definition of felsic was said to be more restrictive, at least in some cases. Terman said that this classification was provisional and would be circulated to the panels for comment and possible revision before formal adoption.

It was further recommended that accretionary terranes be shown in a simple inset map depicting oceanic and continental terranes as recommended by McKelvey in the earlier session on the Tectonic Map Series.

Terman recommended that ultramafic rocks be shown in black, either as solid bodies or by a pattern.

Doutch added that in his view the objective terminology, upon which the map will be based, is mainly lithological, with perhaps superterms for continental and oceanic domains. The interpretive plate-tectonic terminology would be best placed in the accompanying booklet either by the use of a map, chart, or an expanded legend.

Terman announced that these guidelines will be completed and circulated to the Map Committee in the near future. They are intended, he said, to show the individual map compilers how to translate the data from the Geologic Map Series to this series.

Geodynamics Map Series

Discussion chairman George W. Moore called on Terman for a report on the ad hoc group that assembled in Reston, Virginia, on February 23, 1982, to consider the gravity element for the Geodynamics Map Series (table 11). The eight-man group, meeting with Terman as moderator, considered the available data sets including Anthony B. Watts' free-air gravity mapping of the western Pacific marginal basins, the mid-Pacific Hawaiian Islands area, and an area east of Australia (Watts, 1975; Watts and Talwani, 1975; Watts and others, 1978a, 1978b; Watts and others, 1981). Although far from complete, this shipboard-derived free-air mapping is probably the best gravity map of the Pacific basin, according to Terman.

Richard H. Rapp, Ohio State University, has developed a worldwide gravity map based on one-degree mean free-air values. This mapping, Terman said, would be made available to the Map Project upon request.

The gravity advisory group recommended that free-air gravity data be shown both over water and land and that areas over which data are not available be left blank. Contouring should be at a 25-milligal interval. The plan would be to digitize Watts' published data. It was also recommended that Rapp forward to Watts a satellite data tape for the same area as Watts' gravity of the Hawaiian Islands area so that the compatibility of the two could be evaluated. The intent was to ascertain if the satellite mapping could be used to fill in areas in which shipboard data had not yet been contoured. Watts maintained, after study of the information, that the two data sets cannot be merged. He recommended that the surface-ship gravity be used on the maps and that the satellite gravity be shown on a smaller-scale map, possibly as an inset. Terman then suggested to the Map Committee that the surface-ship gravity be printed in full color on the Geodynamics Map Series with the satellite gravity mapping to be provided by Rapp printed on the reverse side of the map.

Terman pointed out that free-air gravity mapping exists for much of the continental area surrounding the Pacific basin, but in some areas, such as parts of Asia, no mapping is available, and these areas would have to remain blank. Terman also noted that the satellite-gravity mapping does not cover the polar areas, extending only from latitude 72° N to latitude 72° S.

The ad hoc gravity advisory group also recommended that two-meter geoid contours be printed on the back of the Geodynamics Maps. According to James Marshall of the National Aeronautics and Space Administration, the geoid map in question is based on a combination of satellite-altimeter data, surface-gravity data, and satellite orbital tracking data. Marsh maintained, in a letter to Terman, that it is important to show the geoid contours as well as gravity anomalies, noting that the geoid, or mean sea surface, is the quantity directly observed by the satellite-altimeter system. Gravity anomalies can be computed from the geoid data, although analyses have been traditionally based on shipboard surface-gravity measurements.

In evaluating strengths and weaknesses of the two kinds of gravity mapping, Terman noted that the surface-ship gravity is readily understood and appreciated by most geophysicists. In the case of the Pacific basin, however, the gravity data now available cover less than half of the map area. The satellite-gravity mapping is more generalized and is at a 10- rather than 25-milligal contour interval. Some of the panel chairmen asked to see an example of the gravity-anomaly mapping derived from the geoid map. Terman agreed and said that he would obtain a complete printout of the satellite-gravity mapping, and that relevant parts of it would be sent to the panel chairmen for review.

Terman reiterated the gravity advisory group's recommendation to use free-air rather than Bouguer gravity over land areas. This met with some resistance, but the idea was not rejected.

The panel chairmen next considered the ad hoc gravity group's recommendation that the Geodynamics Map be reconstituted as a gravity map and that the series be suitably renamed. Other elements from this map series would be redistributed to the Energy Resources Map and the Tectonic Map. It was further recommended by the group that the gravity map follow the coloration developed by Watts (1975).

The panel chairmen considered and rejected the possibility of adding a gravity map to the thematic series, and after considerable discussion they decided to retain the already established Geodynamics Map elements (Addicott, 1980, p. 54-55) with minor changes.

It was agreed that crustal thickness would be shown on an inset map and that the state of lithospheric stress and earthquake first-motion solutions should stay on the Geodynamics Map rather than be transferred to the Tectonic Map. Both the post-Miocene volcano data set and the three-fold classification of post-Miocene faults were moved to the Tectonic Map. Faults with Holocene activity and the Holocene volcano data set, however, were retained on the Geodynamics Map. It was also agreed that the active plate boundaries from the Plate-Tectonic Map sheets should be included. Heatflow point data and geothermal convection systems will be removed to the Energy Resources Map as suggested by the advisory group.

The compilation guidelines for this series, as amended in August 1982, are shown on table 12.

Energy Resources Map Series

Response to a questionnaire developed by Energy Map advisor Paul W. Richards, who also served as discussion chairman for this session, was reviewed item by item in an effort to revise and update the compilation guidelines. The four-page questionnaire had been sent to the panel chairmen and the scientific coordinator in February 1982, together with a background statement on each issue prepared by Richards. Richards announced that responses were received from all of the group polled.

It was agreed that basement rock and volcanic cover would be included as background for the Energy Resources Map. These parameters are to be taken from the Geologic Map Series. All were in favor of showing salt domes on the maps, but, rather than depicting individual domes, these would be shown by areas in which salt domes are numerous and well-developed. Response to the questionnaire favored showing faults on the Energy Map Series, but opinion was divided as to the source; half favored taking them from the Tectonic Map, and the other half favored the faults shown on the Plate-Tectonic Map, but with somewhat fewer faults shown. Further consideration during the meeting brought about agreement that the faults used on the Energy Resources Map would be selected by the individual panels, and that these might or might not come from any of the previously published map series.

A majority of those polled favored showing anticlinal axes, and it was decided during the meeting that these would likewise be selected especially for this map series.

Richards suggested that depiction of sediment thickness by isopachs follow the guidelines worked out by the Tectonic Map subgroup earlier in the meeting.

The response on depiction of sedimentary basins was mixed, but a majority favored showing the basins by drawing a border line around them. Similarly, a majority favored utilizing a simple color hue or tone for showing the extent of the basin and using deeper hues to show increasing depth of the basins. Most were in favor of using an index map to define and name the basins. Rather than use the sets of basin names from two recent sources (Coury and Hendricks, 1978; St. John, 1980), the panel chairmen said that they wanted to develop their own set of names for each map sheet and that the Map Project should come up with its own set of names for the Pacific region.

Responses favored to showing sediment isopachs in the ocean areas. This data set will be taken from the Tectonic Map Series. The original proposal to carry the sediment isopachs out to the edge of the continental rise was discussed at length. It was decided to include coverage for the entire ocean-floor area. This, then, would require depiction of resource data in an accompanying booklet, and abandonment of the earlier plan to show these data on the deep sea-floor parts of the individual map sheets.

A data set prepared by Frank H. Wang, showing the difference in ocean water temperature between the surface and 1,000 meters, was considered for the ocean areas of the Energy Resources Map. A broad equatorial belt in which the temperature range is great enough to serve as a possible source of ocean thermal energy was colored. After discussion, this data set was considered to be more appropriate for the 1:20,000,000-scale base, or an even smaller-scale map.

In keeping with an earlier decision to move geothermal-convection systems and heat-flow data from the Geodynamics Map to the Energy Map, a majority of the panel chairmen indicated their agreement. Addicott noted that Herbert W. Meyers of the World Data Center, Boulder, Colorado, advised him that a new worldwide heatflow data base is being completed and will be available on tape in late 1982. It is expected to be considerably advanced in coverage over information supplied to the Map Project a few years ago. Terman noted that a recent workshop on heatflow in southeast Asia resulted in an updated compilation for that part of the Pacific and that Northwest Panel member Seiya Uyeda should be contacted about this information.

Views on the depiction of oil and gas fields were evenly divided between utilizing the style shown on the 1978 proof of the Northeast Quadrant Energy Resources Map, which utilizes green for oil fields and red for gas fields, and conventions used on the UNESCO (1975) Oil and Gas Map of Southeast Asia (Bhandari and others, 1975), on which giant fields are shown by true-scale outlines and other fields are denoted by a stippled pattern. Doutch pointed out that the symbolization of oil and gas fields used on the Northeast Quadrant was not well suited for the Southwest Quadrant because only one giant field lies on or adjacent to the Australian continent. Richards suggested that project headquarters assist in preparing plots of oil and gas fields for the Australian continent in cooperation with a U.S. Geological Survey project to computerize worldwide drilling data.

All but one of the group favored showing simplified stratigraphic columns for basins containing giant fields. Giant oil fields were defined as having more than 100 million barrels of recoverable oil and giant gas fields as having at least 3 trillion cubic feet of recoverable gas. A majority favored identifying these giant fields directly on the map. Discussion of format and scale for these columns failed to bring about agreement on a standard. Richards then suggested that each panel develop examples and submit them to headquarters, and that these could then be circulated for review and selection by the panel chairmen. He called for at least one of these columns to include a basin that contains a giant coal field.

A majority of the panel chairmen favored not limiting the depiction of oil sand and oil shale to only high-grade deposits.

As for coal, most were in favor of showing the rank and also the age of the coal. Rank would be shown by various kinds of broken lines, and age by use of a letter symbol in association with a line encircling the deposit or area of occurrence.

All but one of those questioned favored showing tabular data to back up the information depicted on the map. The sentiment was for showing this information basin by basin. The revised compilation guidelines (table 13), prepared by Richards following the meeting, reflect the panel chairmen's and scientific coordinator's viewpoints on the kind of information to be shown in tabular format.

Discussion of the definitions of volcanic cover led to an agreement that it would exclude thin volcanic cover that could be penetrated with a seismograph and beneath which prospecting for oil or gas could be carried out. Drummond said that areas of thin volcanic cover of this sort should be stripped from the maps.

Surficial cover, as shown on the Northeast Quadrant Map compilation, includes areas in which extensive surficial deposits of Quaternary age conceal areas that could be underlain by sedimentary basins. Doutch said that this would not necessarily be a useful convention for the Southwest Quadrant. It was concluded by Richards that this could best be left as an optional item for the map series.

Doutch raised the question, "What is a coal field?" He pointed out that Australian maps show coal-bearing formations. Richards responded that coal-bearing formations were also shown on United States maps, and that the coal was considered to be potentially recoverable. Doutch said that this would present a problem on the Southwest Quadrant. Richards responded that there should be enough latitude between individual map sheets to accommodate somewhat different definitions on the quadrant maps, provided that the ground rules are adequately spelled out.

McKelvey drew attention to the recently published 1:10,000,000-scale petroleum and oil-shale map of Australia (Wilford, 1981) which, among other things, shows the limit of the continental rise, discussed earlier in the Tectonic Map session. The map graphics were favorably commented upon, in particular the depiction of the time range of sedimentation periods and the supporting map-margin information on age of producing horizons and reserves of oil and gas.

In response to questioning about the status of Energy Map compilation for each of the quadrants, Corvalán stated that the major effort this year had been put into the Geologic Map of the Southeast Quadrant. The current proof of the Southeast Energy Resources Map was put together by Glen F. Brown in 1980, who retired last year and is no longer working on the map. Corvalán said, in response to a question by Reinemund, that someone should be designated to carry Brown's work to conclusion. He said that he could revise the map and enter new information but would need someone to help.

As for the Northeast Quadrant, Drummond said that the proof completed a few years ago was a joint effort between him and Richards, in which Drummond had supplied oil and gas field information and background geology, with Richards providing coal, oil-shale, and oil-sand information. Drummond indicated that he would add some stratigraphic columns and some of the tabular data to the map, although the proof would need considerable updating and correcting before publishing. He said that he would take over the responsibility of finding someone in the Northeast Panel to take over the updating and completion of this map.

Both Nishiwaki and Doutch indicated that they would take responsibility for the completion of Energy Resources Map sheets for their quadrants. Work on the coal resource depiction on the Northwest Quadrant is well advanced. Doutch said that he would begin work on the Southwest Quadrant later this year following the Circum-Pacific Conference in August.

Jo Anne Stapelton, computer specialist with the U.S. Geological Survey, addressed the group on digital mapping. She reviewed the efforts to digitize the Circum-Pacific bathymetry from the 1:10,000,000-scale maps. The four quadrants were digitized several years ago, based on preliminary bathymetry prepared during the late 1970's. One of the quadrants, the Northwest, has been revised and updated, but the other three are still in a preliminary, uncorrected form. Stapelton reviewed the computer plotting of the earthquake-epicenter data file for the 1:20,000,000-scale map, the volcano data file for the Plate-Tectonic Map, and the Deep Sea Drilling Project well locations for the Geologic Map.

Revised compilation guidelines for the Energy Resources Map Series, completed after further discussion at the Interim Meeting, August 22-23, 1982, are shown in table 13.

Pacific Basin 1:20,000,000-Scale Maps

General chairman John A. Reinemund called for suggestions from the panel chairmen for their views on what maps should be issued and what their contents should be.

Corvalán expressed his opinion that efforts should be maintained, for the present, on the 1:10,000,000-scale map series before contemplating additional maps on the 1:20,000,000-scale base. He said that in his view the 1:20,000,000-scale maps are a by-product of the basic thematic map series. He cautioned against publishing any data set originally compiled for the 1:10,000,000-scale map series on the Pacific Basin base until after it had been fully published at the more detailed scale.

Doutch felt that developing a Tectonic Map at this scale was of considerable importance, suggesting that perhaps it could be combined with mineral-occurrence data. He said that both mineral and energy resources should be portrayed individually at this scale, in keeping with the resource orientation of the Map Project. Other elements that could be represented at this scale are sea-floor sediment and gravity.

Craddock said that it was his understanding that upon completion of the five maps in each 1:10,000,000-scale thematic series a composite 1:20,000,000-scale map would be issued, and that he is in favor of this procedure. His view was that data sets of special interest such as sea-floor sediment and oceanic crustal ages should not be shown individually on the 1:20,000,000-scale base but in groupings, as on the 1:10,000,000-scale map series.

Reinemund observed that because of the distorted land areas around the margin of the 1:20,000,000-scale base it might not be possible to show all of the same land-based information as on the 1:10,000,000-scale maps. His view was that the information could be distilled and combined into fewer 1:20,000,000-scale maps.

Nishiwaki said that he was in full agreement with issuing a sediment map on the Pacific Basin base. His view was that a number of the geophysical parameters could be much better displayed on the 1:20,000,000-scale maps than on the 1:10,000,000-scale maps. He said that this was the case for the sea-floor mineral resources which could best be shown on the total-area map. As for minerals mapping, Nishiwaki noted an earlier suggestion that he and Guild proposed to the Map Committee, whereby the distribution of granitic rock would be compared with tin and base-metal distribution around the Pacific. Granites would be classified as I-type and S-type, together with other information brought together by the International Geological Correlation Programme's (IGCP) Circum-Pacific Granite Project, of which Tamotsu Nozawa, deputy chairman of the Northwest Quadrant Panel, was a lead participant.

It was also stressed by Nishiwaki that the 1:10,000,000-scale base maps are of very large dimension and are both difficult to display and to file. He called for consideration of issuing smaller scale maps at, for example, 1:30,000,000, but suggested that this kind of a second edition should follow publication of the basic map series by at least two years so as not to interfere with sales.

McKelvey noted that the people of the Pacific island nations are primarily concerned with natural hazards and the availability of resources, as explained to the Map Committee at a dinner meeting earlier in the week by Anthony Palomo, Office of the Assistant Secretary for Territorial and International Affairs, U.S. Department of Interior. His view was that a natural-hazards map at the 1:20,000,000 scale should be attempted, and that this could show such parameters as active volcanoes, active faults, and seismic epicenters. The purpose of this would not be so much to show new information as to focus existing information for those people and agencies who are interested in natural hazards, especially from an overview framework. Additional items to be considered would be areas subject to tsunamis, severe floods, or landslides, as well as areas of active land subsidence.

Terman noted a paper in the AAPG volume on Energy Resources in the Pacific Region (Halbouty, 1981) on slope-stability problems related to mineral and energy resources. Although aimed at the interplay of natural processes and the works of man, it underscores the possibilities mentioned by McKelvey. Terman suggested that this article be circulated to the panel chairmen for review.

Guild mentioned his interest in making a map to show the relationship of the distribution of porphyries versus other types of base-metal deposits. He expressed support of Nishiwaki's recommendation on showing stress directions in concert with mineral occurrences.

Addicott drew attention to the preliminary map of accretionary terranes prepared for the meeting by David L. Jones and David G. Howell, noting that work is continuing on this compilation and would be presented to the committee at their August 1982 meeting by Howell.

McKelvey stressed that a considerable amount of data had already been digitized for the 1:10,000,000-scale maps, but that all of the data should be digitized, as well as the maps themselves. There is great potential for use of these maps and data sets in this form, he said.

Reinemund, in summarizing the discussion, called for Guild and Nishiwaki to come up with a list of ideas for depiction of mineral-resource data on the 1:20,000,000-scale map series that could be discussed by the committee in August 1982. He also asked Richards and Drummond to consider the Energy Resources Map and to have recommendations ready for the August meeting.

Reinemund concluded the discussion, seconding Corvalán's recommendation that all efforts be placed on completing the 1:10,000,000-scale map series, and that completion of the 1:20,000,000-scale maps could follow. He noted the effectiveness of the basin-wide Plate-Tectonic Map and the potential value in interrelating data from the individual map sheets on this base. He again cautioned on limitations in depicting data in the distorted land areas around the margins of the map. Finally, he called for a listing of those parameters from the Geologic and Tectonic Maps on the one hand, and the Mineral and Energy Resources Maps on the other, that could be advantageously combined on the 1:20,000,000-scale total-area maps with the view of having individual mineral-resources and energy-resources maps at that scale.

Future Plans

Reinemund told the Map Committee that Circum-Pacific Council Chairman Michel T. Halbouty and he met with U.S. Geological Survey Director Dallas L. Peck and Chief Geologist Robert M. Hamilton in April 1982 to discuss their views for the future of the Circum-Pacific Map Project. All were in favor of continuing this work, and it was agreed that plans for future efforts should now be made, although no specific directions were agreed upon.

Reinemund outlined several suggestions for further work that had been made: paleogeologic maps, geologic-hazards studies, completion of the resources data banks, digitization of resource data, resource-assessment studies, geologic syntheses summarizing information that has gone into the maps, cross sections, stratigraphic analyses particularly of the relationship of continental to oceanic areas, digitizing of the maps, and ongoing revision of the maps.

Rather than adding to this list or revising it at this time, Reinemund suggested that the committee take up the question of future directions at the Interim Meeting in August. He added that to become involved in some of these new kinds of investigations it would be necessary to bring new specialists into the project so as to broaden our capabilities. He encouraged members of the committee to consider future projects and to send these ideas to him so that they could be synthesized and prepared for discussion at future meetings of the committee.

INTERIM MEETING

Introductory Remarks

General Chairman John A. Reinemund opened the Interim Meeting of the Map Project at 9:00 a.m., Sunday, August 22, at the Hilton Hawaiian Village Hotel in Honolulu, Hawaii, welcoming some 40 Map Committee members and visitors (table 14). He introduced Circum-Pacific Council Chairman Michel T. Halbouty, who welcomed the committee members to the Fourth Circum-Pacific Conference. Halbouty announced that the Circum-Pacific Council for Energy and Mineral Resources (CPCEMR) had become affiliated with the AAPG as an international section. This move was made, he said, to ensure continuity of the council's work, including the Map Project. Halbouty expressed pleasure with the accomplishments of the Map Project and underscored the potential benefits of this work to some of the less developed countries in exploration for mineral and energy resources.

Reviewing the functioning of the newly structured CPCEMR, Halbouty reported that the council will be led by a board of 17 directors. There will be two directors from each quadrant and one representing Antarctica. There will be four directors at large and four directors will also be council officers. After initial appointment by the council, the directors will be elected by delegates from each quadrant. Each country will be represented by a council delegate. Initially the delegates will be appointed by the directors for each quadrant, but later they will elect the directors for each of the quadrants and Antarctica. The council president will be elected one year prior to the quadrennial conference and will serve for four years beginning at the time of the conference. There will be a Map Committee, Educational Committee, Finance Committee, and Conference Committee. Officers include a president, a president-elect, a first vice-president, a second vice-president who will be the conference chairman, and a secretary-treasurer. Tentative plans are to hold the next conference in Singapore in 1988. Later in the week Halbouty announced that Reinemund had been appointed to the board and will also fill the newly created position of Circum-Pacific Map Project Director, and that Addicott had been named to replace him as Map Project General Chairman (figure 9).

Conference Chairman J. Erick Mack, Jr., reviewed the program and arrangements for the CPCEMR Conference, thanking the Map Committee for their contributions to the program and exhibits.

Theodore Beaumont, AAPG Science Director, advised the committee that sales of the Circum-Pacific Maps are doing very well. He called attention to the map sales report (table 6), noting that sales of the Geographic Maps had picked up considerably during the past year. He called attention to the recent publication of the explanatory booklet for the Plate-Tectonic Map Series (Moore, 1982), which completed the Plate-Tectonic Series. The booklet is being distributed free of charge by AAPG with each Plate-Tectonic Map order. Following the meeting, it was decided to market separate copies of the booklet for $1.00. AAPG also moved to raise the price of the Plate-Tectonic Map sheets from $8.00

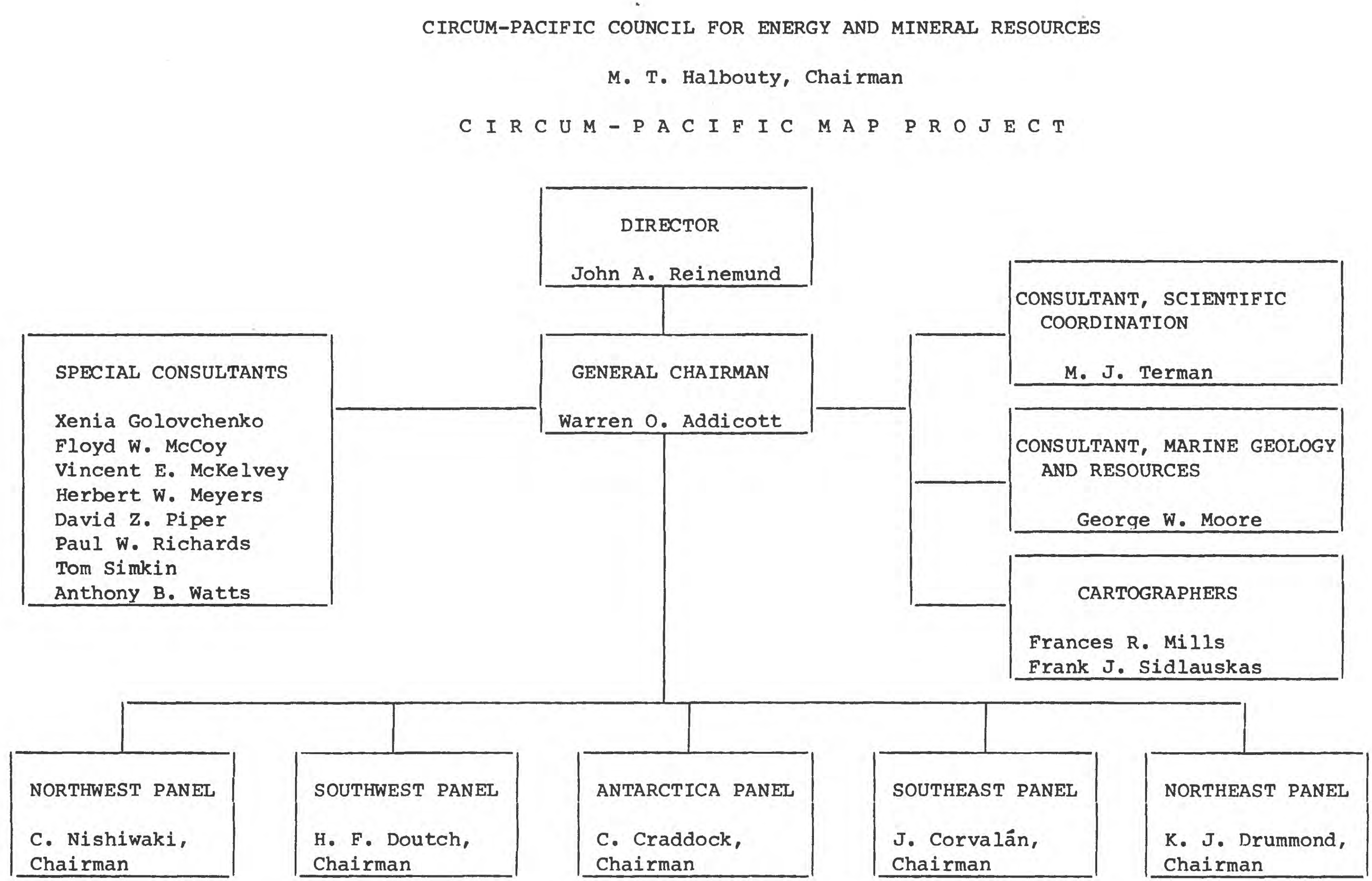

Figure 9. Organization chart of the Circum-Pacific Map Project. Panel members are listed in table 2.

to $12.00 per map sheet and from $32.00 to $40.00 per set effective January 1, 1983. The plan, according to AAPG Special Projects Manager Ronald L. Hart, is to price subsequent maps in the Circum-Pacific Series at the same level.

Reinemund introduced Dr. Eugene Seibold, president of the International Union of Geological Sciences (IUGS), who addressed the group briefly. Maps are never completed, Seibold noted, they can always be improved in the process of working toward truth. He wished success to the Map Committee with their meeting and their poster session symposium (Corvalán, 1982; Craddock, 1982; Doutch, 1982; Drummond, 1982; Guild and Lee, 1982; Jones and others, 1982; McCoy, 1982; Nishiwaki and others, 1982; Piper and others, 1982; and Scheibner, 1982) during the conference.

Frances Delany, Secretary General of the CGMW, reviewed the status of CGMW map compilations of interest to the Map Committee. Among these were the soon-to-be-published Tectonic Map of South and East Asia, a final proof of the Metallogenic Map of South America to be completed in September 1982, a plan for an Energy Resources Map of South America, and the Geologic Map of South and East Asia which is still being compiled.

Delany pointed out what were in her view several cases of needless duplication of mapping efforts throughout the world, citing certain examples. Discussion of this problem brought out Reinemund's view that the CGMW, a very old commission that predated the IUGS, should serve as a clearing house and focal point for the coordination of geologic mapping throughout the world. This, he declared, had not always been the case, as indicated by Delany's comments. Reinemund noted that a principal reason for Delany's participation in the Map Project meetings was to avoid potential duplication between the two organizations. And it was the view of many of the panel chairmen and map advisors that duplication of effort with CGMW was not a problem.

Several commented on the role of CGMW in worldwide mapping and, specifically, the interrelationship with efforts of the Map Project.

Reinemund noted a communication from E. L. Winterer, Pacific Ocean specialist on the International Oceanographic Commission's Geological and Geophysical Atlas of the Pacific Ocean (GAPA), outlining the various maps that this Soviet Union-led effort has planned. Listings of the maps and principal compilers were circulated and discussed. Reinemund said that Eric S. W. Simpson, deputy editor of the atlas, had promised to keep the Map Committee informed of progress toward completion of the GAPA project for which a completion date of 1986 had been set.

Nishiwaki informed the Map Committee of the Japanese language television series on plate-tectonics made by the Japanese National Broadcast Company. The program was aired in August 1982 in Japan, on prime-time television for five consecutive days, receiving a 27 percent audience rating. Nishiwaki, scientific consultant for the series, noted the curiosity of young and old people alike about earth science, and he underscored the potential usefulness of the Plate-Tectonic Map as a teaching aid to the general earth-science curricula in Japan.

Geologic Map Series

Warren O. Addicott, discussion chairman, described new color proofs of the Northeast and Southeast Geologic Map sheets that were completed under the direction of cartographer Frances R. Mills. Color separations for the map proofs were made by computerized scanning of unit boundaries that were color coded with small dots of colored ink. This process, Addicott pointed out, is efficient in shortening the time required for conventional cartographic preparation of color plates, and it also allows computerized adjustment of color values, in addition to facilitating author correction. With the information in computer storage, it is a relatively easy procedure to change scale or projection, Addicott added.

Floyd W. McCoy, compiler of the sea-floor-sediment element, advised that only a relatively small part of the Antarctica Sheet remained to be completed. Data for the Weddell Sea have been secured; this area and some new areas opened up in the south Atlantic by the new Antarctica map projection are the only unfinished parts of the map sheet. Most of the sheet overlaps the ocean parts of the Southeast and Southwest Quadrant sheets. Addicott summarized efforts to secure digitized bathymetry for the new projection from the U.S. Naval Oceanographic Office at Bay St. Louis, Mississippi, concluding that work should proceed using the existing bathymetry to control sediment distribution patterns, where needed.

The Northeast Quadrant proof, according to Panel Chairman Kenneth J. Drummond, will be reviewed by panel members Guillermo P. Salas of Mexico, Hubert Gabrielse of Canada, and James E. Case of the U.S. Geological Survey, who will review the Central American and northern South American parts of the proof.

Campbell Craddock, Antarctica Panel Chairman, announced that his compilation of the Antarctica continent was displayed at the August Antarctic Earth Science Meeting in Adelaide, Australia, a meeting which attracted some 200 Antarctic geologists. Comments received from attendees and from panel members were to be incorporated into his final compilation, which he expected to complete by the end of September 1982. H. Frederick Doutch, Southwest Quadrant Panel Chairman, recommended that the new Antarctica Sheet be extended 4° farther north--from 30° S. to 26° S.--so as to better depict the breakup boundaries of Gondwana on this sheet.

Doutch said that the Southwest Geologic Map was completed, excepting part of the northern overlap area, which was being revised by the Northwest Panel. The map was to be drafted by the time he returned from the meeting and he requested additional time so that the compilation could be checked by colleagues in the Bureau of Mineral Resources. Doutch expressed concern that the color schemes used for the Southeast and Northeast Quadrants would not permit adequate differentiation of units on the Southwest Quadrant. He emphasized that the color needs of the other three map sheets needed to be taken into consideration before printing the two eastern maps. The explanatory paragraph carried in the map margin was considered inadequate for the Southwest Map sheet by Doutch. He distributed a handout indicating his preferred wording the following day.

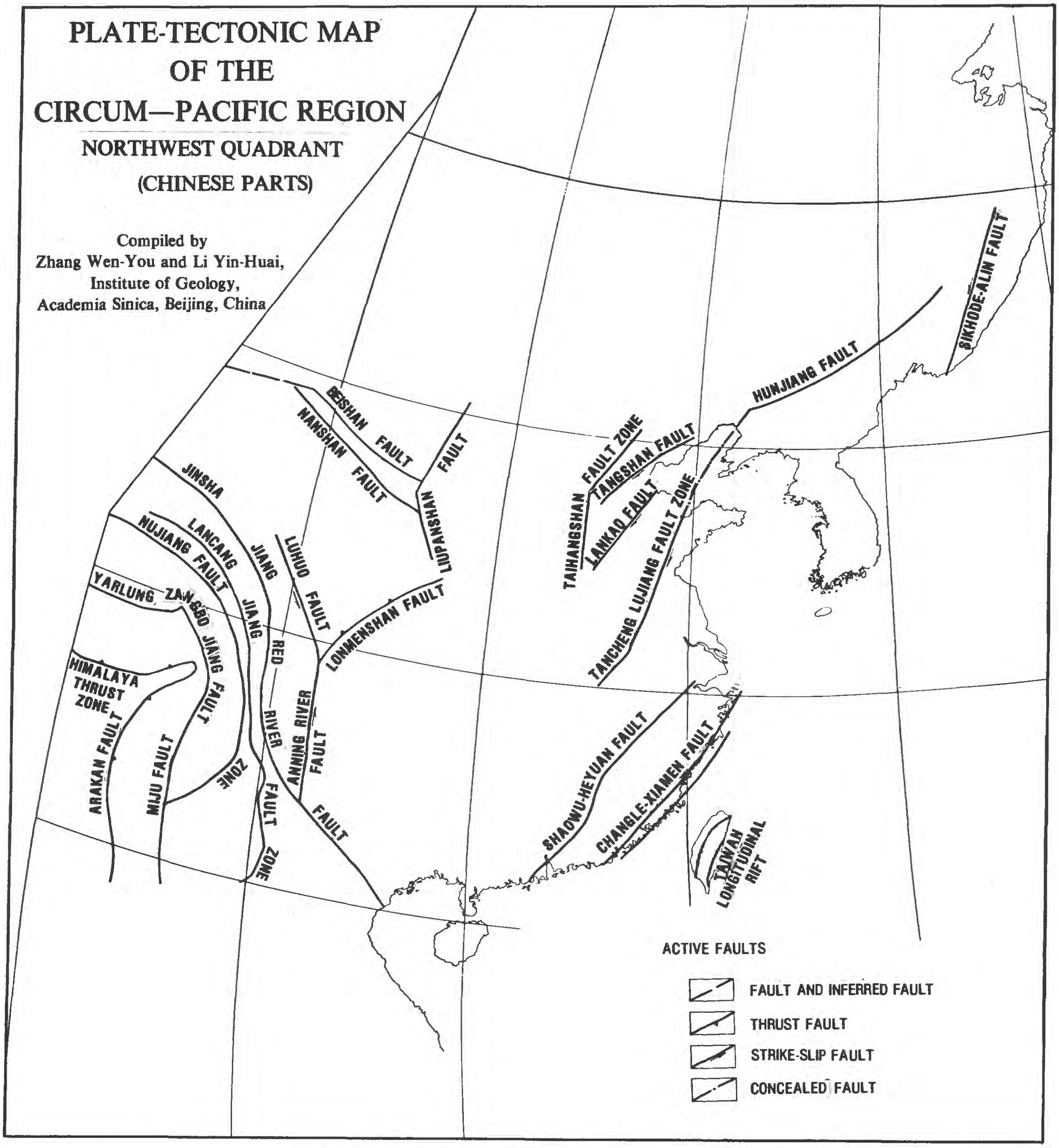

Figure 10. Major intraplate faults for the China part of the Northwest Quadrant Plate-Tectonic Map drawn by Zhang Wen-you and Li Yin-huai, August 1982. Approximate scale 1:35,000,000.

Figure 11. Interim Meeting of the Circum-Pacific Map Project, Honolulu, Hawaii, August 22, 1982. From left to right: John A. Reinemund, Chikao Nishiwaki, Tamotsu Nozawa, Zhang Wen-you, M. J. Terman, George W. Moore, Vincent E. McKelvey, Frances Delany, and José Corvalán.

A special group of three geologists from the Northwest Quadrant was empaneled following the May 1982 Map Project meeting in order to recompile the Northwest Quadrant Map. Panel Chairman Chikao Nishiwaki noted that the new compilation will be reviewed at the December 1982 Northwest Panel meeting in Tokyo. The final compilation will be ready by the end of the year, and Nishiwaki urged that printing be carried out as soon as possible thereafter, noting the delays that caused the previous Northwest compilation to become obsolete.

Zhang Wen-you, panel member from China, presented a revised compilation of geologic units for the Northwest Quadrant Map. He called for a tripartite correlation diagram based upon (1) isotopic ages, (2) sedimentation, and (3) biostratigraphy. Zhang also noted certain inaccuracies in placement and naming of faults shown on the Plate-Tectonic Map of the Northwest Quadrant and supplied headquarters with a map showing correct nomenclature (figure 10). Addicott said that corrections would be made on the maps when they are next reprinted.

Jose Corvalán, Southeast Panel Chairman, told the committee that the Southeast Geologic Map was ready to go to the printers once a few minor corrections were made. George W. Moore, Special Consultant for Marine Geology and Resources, recommended that a simple rendering of the active plate boundaries, shown on the Plate-Tectonic Map, be included on the 1:10,000,000-scale Geologic Map. He claimed that they would be useful as points of geographic and geologic reference. No action was taken on this recommendation.

The schedule for submittal of final compilations of the remaining Geologic Map compilations to headquarters was determined as follows:

Northwest Quadrant - January 1, 1983

Southwest Quadrant - October 15, 1982

Antarctica Sheet -

Land geology - October 1, 1982

Sea-floor sediment - November 15, 1982

Addicott announced that manuscripts for explanatory booklets to accompany the Southeast and Northeast Quadrant Map sheets were nearly completed and would be ready for printing by the end of the year.

Tectonic Map Series

Discussion chairman Maurice J. Terman, Consultant for Scientific Coordination, reviewed the status of the compilation guidelines based upon modifications made during and after the May 1982 Map Project meeting in Reston, Virginia. Some changes included: (1) addition of active plate boundaries from the Plate-Tectonic Map, (2) depiction of areas of salt domes rather than individual occurrences, (3) inclusion of a small inset map showing tectonic terrane as to active-margin, passive-margin, oceanic, and continental-crust types with a text statement of explanation, and (4) a decision to let the edge of the oceanic crust be used to indicate the ocean-continent boundary rather than a specific line. Terman also recommended that the crustal-thickness inset map for each sheet be prepared by a single compiler from a worldwide data base.

Erwin Scheibner, Southwest Quadrant Panel member and chief compiler of the Southwest Tectonic Map, presented his new compilation. He advised the Map Committee that it was his philosophy to make the map as simple and as objective as possible. Unit boundaries are taken directly from the Geologic Map in almost all cases, he said. In the eastern part of Australia, Scheibner pointed out that it was possible to show igneous rocks as to source character, for example, I-type, S-type, A-type, and M-type. He observed that this kind of classification would have considerable importance in exploration.

Scheibner reviewed the interpretive categorization of units on his map including modifications of the earlier guidelines. He recommended using the same letter symbols as on the Geologic Map and adding numbers keyed to a list of tectonic interpretations that he discussed with the committee (table 13). This list, he said, could either be printed directly on the map, or if too extensive, in the accompanying booklets. This approach would allow the use of multiple tectonic interpretations for some of the maps if these were desirable. Scheibner noted that he had used general terminology wherever feasible in order to keep plate-tectonic bias out of the scheme as much as possible.

Tamotsu Nozawa, Northwest Quadrant Vice-Chairman and principal compiler of the Northwest Tectonic Map sheet, questioned the criteria utilized in setting up metamorphic rock categories for the map, saying that their definitions were not at all clear. Scheibner suggested adopting a classification based upon metamorphic type, but Terman pointed out that, owing to the advanced stage of compilation of the various maps, it was now too late to change the classification.

Terman acknowledged continuing differences in opinion between Australian and United States specialists on usage of tectonic terminology, suggesting that a small group, consisting of Scheibner, Doutch, Moore, and himself, meet and work out a compromise. Scheibner agreed, specifying that, insofar as possible, the second edition of the American Geological Institute Glossary of Geology (Bates and Johnson, 1980) be used in preparing final guidelines. Doutch suggested that the next few days could be used to come up with a final version of the guidelines that could then be adopted by the panel chairmen before the conference closed.

Corvalán said that the panel chairmen should take part in the final decisions. Nishiwaki expressed pleasure with the appearance of the Southwest Map. He asked that guidelines be finalized before the end of the meeting so that the Northwest Panel could proceed with compilation of their map concurrently with the Geologic Map so as to have a preliminary compilation ready by May 1983. Craddock said that compilation of the Tectonic Map of Antarctica had not yet been started. It was his view that the panel chairmen should either take part in the discussions of the ad hoc group or at least be able to meet to approve them before the conference concludes. Reinemund agreed that the guidelines had to be resolved before leaving Honolulu. He requested that a committee composed of Terman, Scheibner, and Moore meet to work out an amended document that would then be subject to review by the panel chairmen. Moore stressed that a layout of all map margin material for the Southwest Tectonic Map should be made as soon as possible and circulated so that an acceptable format could be adopted by the committee.

David G. Howell of the U.S. Geological Survey presented a 1:20,000,000-scale tectonostratigraphic terrane map prepared expressly for the meeting and the Circum-Pacific Conference (Jones and others, 1982). Howell explained the criteria for terrane analysis (Jones and others, 1983), noting that individual terranes are fault-bounded packages of rocks having unique stratigraphic sequences of units that differ from contiguous terranes. Work in North America has recently been followed by similar analysis in the western Pacific by earth scientists from Japan, he said. Howell characterized the margins of the Circum-Pacific region as a collage of accreted terranes, the understanding of which would lead to new ideas in the exploration for resources. Howell's map illustrated Archaean massifs that, in his view, carried plate-tectonic activity back to at least 3.8 billion years. He pointed out areas of inferred Paleozoic accretion. Dominantly graywacke terrane, island-arc terrane, oceanic plateaus, and ophiolitic sequences were depicted on his map. Howell stressed that this was a preliminary map and that he and his colleagues were planning to obtain collaboration from other countries in an effort to refine this initial effort.

Mineral Resources Map Series

Philip W. Guild, Minerals Map Advisor and Northeast Quadrant Panel member, presented the second color proof of the Northeast Quadrant Minerals Map sheet, completed a few days before the meeting. The proof, made in Reston, Virginia, under the direction of Frank J. Sidlauskas, included 49 individual photographic plates. Guild estimated that the map could be ready for final printing in about three months, but another proof will be made in order to adjust the coloration of background geology and sea-floor sediment, together with the associated patterning. Guild noted that the background geology, taken from the Geologic Map Series, had been interpreted in terms of the essential nature of the geologic environment of the ore deposits independent of age. Classification and depiction of the ore deposits followed a scheme set up by Guild in 1975. He estimated that some 3,000 deposits were shown on the Northeast Quadrant proof. Accreted terranes could be shown on the map in Guild's view, but John P. Albers questioned whether it was feasible to show these individually on an already complicated map. His suggestion was to depict the terranes by combining them as to genetic type in consideration of the scale of the map.

David Z. Piper, Marine Minerals Consultant, reviewed changes in the depiction of sea-floor sediment and nodule abundance data from the color proof completed in May 1982. Piper said that coloration of the geologic background will need to be enhanced in order to clearly differentiate it from sea-floor-sediment units. On this proof the four basic sediment colors were subdivided into lighter to darker tones to depict deeper bathymetric intervals. Piper called for further enhancement of the contours depicting nodule abundance and also of the colors for symbols that depict nodule chemistry.

Terman noted a recent discovery of cobalt-rich crusts at relatively shallow depths in the central Pacific west of the Hawaiian Islands, questioning if these could be depicted on the map.

Addicott discussed plans to make three-quarter-scale colored photographic copies of the Mineral Resources Map proof for review by the panel chairmen. Full-scale black and white copies of the map were also to be included in the mailing. Addicott asked the panel chairmen and other Map Committee members to visit the map exhibit during the conference in order to make corrections and comments directly on the proof.

Nishiwaki noted that the three metamorphic categories specified in the guidelines were not sufficient for the needs of the Northwest Quadrant, and said that he wished to indicate I-type and S-type granites on the geologic background. McKelvey responded that in his view there was no reason why the geologic background could not vary in detail from one quadrant map to another.

Corvalán said that the background geology was a very important question to be considered beyond the general directive that a simplified geologic background should be used. The background developed for the Southeast Quadrant Minerals Map sheet has been simplified in the case of some units from the Geologic Map in order to highlight those units most significant for ore occurrence.

Figure 12. Mineral Resources Map subcommittee meeting held in the exhibits area during the Third Circum-Pacific Conference on Energy and Mineral Resources. From left to right: Michael P. Lee, H. Frederick Doutch, Philip W. Guild, José Corvalán, Chikao Nishiwaki, Kenneth J. Drummond, Erwin Scheibner, and Warren O. Addicott.

Corvalán said that the Southeast Map is ready for cartography, although he would like to make some minor changes in the geologic background. Age ticks for the mineral-deposit symbols needed to be added, but in his view use of these ticks was optional according to the guidelines. He said that the map would be greatly delayed by the time needed to determine ages of mineralization for each deposit. Piper added that the sea-floor-minerals mapping for the Southeast Quadrant has been completed. He pointed out the possibility of obtaining additional photographic information from the Soviet Union through an exchange agreement to be worked out by E. L. Winterer of Scripps Institution of Oceanography, a principal participant in the UNESCO Intergovernmental Oceanographic Commission's Geological and Geophysical Atlas of the Pacific Ocean. Piper said that he would like to have until next summer to try to obtain these data and that the data, if obtained, could be readily added to the map. In any event, he said, the map should not be delayed beyond next summer.

Craddock indicated he had not been able to start a Minerals Map for Antarctica, although he has some material that was compiled by former panel chairman F. Alton Wade. He predicted that ultimately some 200 to 300 mineral localities would be shown on his map.

Figure 13. Panel Chairmen José Corvalán (left) and H. Frederick Doutch (right) in discussion with project cartographer Frances R. Mills (center) during Third Circum-Pacific Conference.

Once the Southwest Quadrant Tectonic Map sheet is finished, Doutch plans to begin compilation of the Minerals Map. He said he had hopes of obtaining help in compiling this map from within his bureau, and predicted that he would have something substantial to display at the 1983 Map Project meeting. Nishiwaki predicted that a preliminary draft of the Mineral Resources Map of the Northwest Quadrant would be completed by the next project meeting. Final copy should be ready within a year following completion of the Tectonic Map. Although a compilation of many of the mineral deposits will have been completed by the next annual meeting, considerable work remains to be done on the geologic background. Nishiwaki told of plans to include special tectonic symbols such as inactive subduction zones that are of significance in mineral genesis. Guild cautioned against turning the Mineral Resources Map into a metallogenic map and, in so doing, take additional time to complete them.

McKelvey recommended that the 200-nautical-mile limit be shown on the maps as an element that would be of use to the various Pacific nations in delimiting the extent of their mineral resources. In his view the Mineral Resources Map would be the most logical map series on which to show this boundary. The outcome of discussion on this proposal was to include a nautical-mile bar scale in the explanation rather than showing a line directly on the maps.

Reinemund noted that Woods Hole Oceanographic Institution was planning to make a series of maps showing this boundary together with existing treaty boundaries, the 2500-meter isobath, and other information. They were planning to print two maps of the Arctic regions and had approached him about the possibility of making a similar map of the Pacific Ocean, utilizing our base. Reinemund said that our base was available for their use but that, as a project, it was doubtful that we would want to get involved.

Reinemund recommended that a brochure be prepared to accompany each of the Minerals Map sheets, noting the precedent set by brochures prepared for the Plate-Tectonic and Geologic Map Series. Response from the panel chairmen was generally favorable, the only question being individual brochures with each sheet or a single brochure to accompany all the maps of a series.

John P. Albers presented a recently completed derivative map showing mineral belts and terranes. Originally compiled on a 1:5,000,000-scale base, the map depicted individual or closely related mineral commodities by broken outlines drawn so as to define mineral belts within the trends of individual terranes. Accreted terranes were grouped into either oceanic crust or island-arc crust. They were compiled from Jones and others (1981), Monger and Price (1979), Monger and others (1982), Coney and others (1980), and unpublished work by Norman J. Silberling in western North American and Maria Fernanda Campa and Peter J. Coney in Mexico and Central America. Also mapped on this compilation were post-accretionary terranes--great volcanic fields or sedimentary rock--and cratonic rocks. Definite patterns of mineral distribution were noted within these terranes. Virtually all the scarn-type iron deposits occur in island-arc accretionary terrane both in Mexico and the United States, according to Albers. Gold is present in some island-arc and oceanic terranes farther inland. Copper and molybdenum deposits are restricted to island-arc crust east of the Coast Range batholith in Canada. Farther inland, virtually all the tungsten deposits are in a belt at the edge of the craton, and beyond that is a belt of barite.

Albers summarized his presentation, noting that within the coastal array of accreted terranes, mineral belts are parallel to the terranes, but the North America craton contains some transverse, east-trending mineralized belts. During questioning, he pointed out that the mineral belts depicted on the map were, in his opinion, more interpretive than the terranes. Reinemund encouraged Albers to continue to perfect this map during the months before the next meeting, at which time it would be reconsidered for possible publication as an experimental map.

Energy Resources Map Series

Discussion chairman Moore called for progress reports by the panel chairmen. Drummond, commenting on Northeast Quadrant work, said that although a proof was completed about three years ago, considerable work remains to be done. His plans were to begin finalizing the map during the next few months. A major project is to compile stratigraphic columns for the basins containing giant fields. These, he said, would best be placed in a separate document.

Figure 14. Northwest Quadrant Panel Chairman Chikao Nishiwaki (left), and Vice-Chairman Tamotsu Nozawa (right) at Northwest Quadrant poster-session booth, Third Circum-Pacific Conference, Honolulu, Hawaii.

Corvalán outlined the status of the Southeast Quadrant, noting that two color proofs have been made so far. He has modified the geologic background and some oil and gas field data from Glen F. Brown's compilation. There was, however, considerable updating of the map to do. Moore and Corvalán discussed the problem of guidelines for the geologic background for this map series at length. It was clear that uniform treatment was desirable, and that this had not yet been spelled out in the guidelines. Headquarters was asked to develop a plan for unifying treatment of this map element.

Several weeks after the meeting, Corvalán advised that two newly appointed panel members, Eduardo González P. and Alfredo Lahsen A., both of Chile, would take over completion of the Energy Resources Map of the Southeast Quadrant.

Doutch announced that the 1:10,000,000-scale coal map of Australia was being printed and called for a better definition of coal-bearing areas in the guidelines. Still ahead for the Southwest Quadrant Map is compilation of stratigraphic columns, heatflow point data, and geothermal sites. Doutch indicated that once the Geologic Map is compiled, his principal effort will be on completing the Energy Resources Map. A preliminary compilation should be ready for display at the 1983 Map Project meeting.

The Northwest Quadrant compilation is well advanced, according to Nishiwaki. If oil and gas field data could be obtained for mainland Asia, the map could be completed within a few months' time, he said. Coal deposits are mapped but, again, up-to-date information for the Asian mainland is needed to complete the map. Panel member Seiya Uyeda is assisting in the compilation of heatflow data.

Herbert W. Meyers, World Data Center A, told the committee that the worldwide heatflow data set will be completed before the end of the year (1982) and will be available to the project. Coverage of this set is through January 1, 1982.

Moore summarized the discussion, noting that some progress in completing this map series has been realized. Major problems to confront during the next few months are the addition of basin names, completion of isopach mapping for continental areas, and preparation of stratigraphic columns for basins containing giant fields.

Geodynamics Map Series

Discussion chairman Terman reviewed the recommendations of Tom Simkin, Smithsonian Institution volcanologist, on depiction of the post-Miocene volcano data set. Originally this data set had been earmarked for the Geodynamics Map but at the May 1982 project meeting it was transferred to the Tectonic Map Series. A major recommendation of Simkin's was that the originally planned three-fold classification (Richards, 1979, p. 36) very likely could not be followed consistently in the case of rock type. Drawing attention to a letter from Simkin in which this and other problems were enumerated, Terman requested that the panel chairmen consider them and make their recommendations known to Map Project headquarters.

Terman noted that the three-fold fault classification, originally scheduled for this map series, would be replaced by faults with Holocene activity, coordinate with the Holocene volcano data set. Another action taken in May was to include active plate boundaries on the Geodynamics Map Series.

Included in the meeting materials were sample gravity maps at 1:10,000,000-scale for the Hawaiian Islands area, one developed from surface-ship gravity data at a 25-milligal interval from published data (Watts and Talwani, 1975), and the other from SEASAT gravity data at a 10-milligal interval.

Terman noted that the SEASAT gravity data could be machine-contoured and could be secured at no cost to the project. Its disadvantages, he said, were that the gravimetric anomalies near land tend to be inaccurate, as evidenced by the line of positive anomalies that were displaced about one centimeter east of the Hawaiian Island chain.

The surface-ship gravity mapping, according to Terman, is much more familiar to gravity specialists, and, as mentioned above, more accurate near land. The disadvantage with this information is that Pacific Ocean coverage is incomplete--large areas have not been mapped. Another problem, Terman noted, would

Figure 15. Michel T. Halbouty (right), Chairman of the Circum-Pacific Council for Energy and Mineral Resources, converses with Li Yin-huai (left) and Zhang Wen-you, Northwest Quadrant Panel members, at Interim Meeting in Honolulu, Hawaii. Guillermo P. Salas in background.

be the cost of digitizing the shipboard-gravity mapping. Watts recommended in a letter to Terman that both data sets be used on the Circum-Pacific Maps but that they not appear on the same sheet. His suggestion was that the SEASAT data should appear on the 1:20,000,000-scale base.

Doutch and Drummond both questioned the joining of land gravity data with the SEASAT gravity along the continental margins, especially in view of the offset of anomalies near land masses previously noted. Nevertheless, Drummond recommended that the SEASAT gravity be used by the project, in view of the total coverage of the ocean aras.

Terman next called attention to a crustal-thickness map of the world, included in the background material for the meeting. He noted that one-kilometer contours could be provided to the project by a group working in Virginia, presumably at no cost. This information, he noted, would best be included on an inset map.

Other geophysical data sets that could be included as insets on the Geodynamic Map sheets, according to Terman, were magnetic-anomaly mapping (MAGSAT

Figure 16. Floyd W. McCoy (left), compiler of sea-floor-sediment element for the Geologic Map Series, confers with Vincent E. McKelvey and David Z. Piper (right), authors of sea-floor resources for the Mineral Resources Map Series, at Interim Meeting in Honolulu, Hawaii, August 22, 1982.

data) and geoid anomalies, both derived from satellite data. He called attention to a sample 2-meter geoid contour map, noting that certain members of the gravity panel that met on February 17, 1982 recommended that a geoid map be printed on the back of the project gravity map. This mapping, Terman said, could be computer-printed onto the project's equal area base.

Terman seconded the gravity panel's recommendation that the geoid data be printed on the reverse side of the map, suggesting that the MAGSAT data be included with them. Moore objected to printing information on the back of any of the maps, noting the usefulness of being able to superimpose any combination of maps over a light table for comparison of geologic and geophysical data with resource occurrences.

In response to questioning by Herbert W. Meyers about obtaining land-gravity coverage, Terman said that this would be the responsibility of each panel, the information coming, presumably, from published sources. He then suggested that the SEASAT, MAGSAT, and geoid-anomaly mapping be obtained and computer-printed onto the Southwest Quadrant Map and the Northwest Quadrant Map for study at one-day annual meetings of these panels to be held in Wellington, New Zealand, in November 1982, and in Tokyo, Japan, in December 1982, respectively.

Reinemund suggested that these maps, and the Plate-Tectonic Map, be reduced and printed on a set of smaller scale (1:30,000,000 or 1:40,000,000) Pacific Basin maps so that the various kinds of maps can be readily compared.

In concluding the discussion, Reinemund asked the special Tectonic Map committee composed of Doutch, Scheibner, Moore, and Terman to also outline the steps necessary to bring about the experimental printing of the various geophysical data sets considered during the session.

Pacific Basin Maps and Future Projects

Reinemund reviewed possibilities for new projects such as were discussed during the May 1982 Map Project meeting. Observing that the basic series of thematic maps was still a major effort for the Map Committee, he recommended that project headquarters prepare a statement including all of the future projects that had been suggested for circulation to the panels and map advisors.

Halbouty recommended that the Map Committee consider making detailed geologic and resource maps of developing countries, such as in the Southeast Asian region, as an integral part of a second phase of project work following completion of the already-planned thematic maps.

With regard to experimentation, Reinemund noted the innovative 1:20,000,000-scale compilation of accreted terranes presented by Howell and the 1:10,000,000-scale mineral-deposit and terrane map of the Northeast Quadrant compiled by Albers. He encouraged the authors to finalize their compilations, expressing his view that both products were of such interest to the geologic community that the Map Committee should decide at the 1983 project meeting what action should be taken to make these available. In the meantime, he advised the panel chairmen that a suggested course of action would be developed by Terman, Addicott, and himself, and circulated for their reference.

Reinemund recommended that the Map Committee consider publication of a 1:20,000,000-scale derivative of the Geologic Map Series. Included on this map would be sea-floor sediment as a principal component. Other elements that could be included were sea-floor manganese nodule data, active plate boundaries, volcanoes, and intraplate structures. His view was that such a map would highlight the sea-floor-sediment mapping which is an important new contribution from the Map Project. Doutch suggested that, on land, surficial deposits and associated mineral deposits could be shown, deposits that are roughly analogous to the surficial sediment in the ocean basins. Reinemund also mentioned the possibility of making a map that focused on oceanic crustal ages. Accreted terrane and elements from the Plate-Tectonic Map could be included, he said.

Nishiwaki questioned if it was now the policy of the Map Committee to issue a 1:20,000,000-scale Pacific Basin Map with each of the basic thematic map series, as was the case with the Plate-Tectonic Map. His view was that

Figure 17. Map Project Director John A. Reinemund (left) and General Chairman Warren O. Addicott at a press briefing in Honolulu, Hawaii.

this course of action would enhance the sale of the thematic map series. He reiterated his view, expressed earlier, that 1:30,000,000-scale thematic maps of the Pacific Basin Map would be of great interest to earth scientists in Japan. Reinemund responded that issuance of 1:20,000,000-scale maps for each of the series had proved to be an excellent idea and should be followed so far as is feasible.

At the conclusion of the discussion, Reinemund summarized comments and views expressed by the committee, recommending that the next map on the 1:20,000,000-scale base show sea-floor sediment as the key element, together with manganese nodule distribution, surficial sediment on land, and major surficial mineral deposits on land. There was general but not unanimous agreement to this proposal. Reinemund then directed project headquarters to prepare a listing of elements that might go on this kind of a map and circulate it to the panel chairmen for comment and eventual formulation of a specific plan for the next thematic map on the 1:20,000,000-scale base.

Map Project Participation in the Third Circum-Pacific Conference

A poster-session symposium outlining the status of map compilation during the Third Circum-Pacific Conference on Energy and Mineral Resources was convened by the Map Committee on August 25. Ten poster papers were presented by the panel chairmen and principal map contributors. Abstracts of these papers and papers by Map Project participants presented during the general sessions, were issued by the Map Project as a special publication at the conference. Copies of this 20-page report are available from project headquarters, 345 Middlefield Road, MS 52, Menlo Park, California 94025, U.S.A. Some of the Map Project papers will be included in the Transactions volume of the Third Circum-Pacific Conference, which is scheduled for publication during 1983.

A massive 4- by 5-meter raised-relief map expanded from the 1:20,000,000-scale Pacific Basin sheet of the Geographic Map Series was displayed in the grand hall during the Honolulu conference. Conference exhibits manager Walter C. Black of the U.S. Geological Survey prepared selected elements from the Plate-Tectonic Map Series for display in this exhibit, including plate boundaries, plate motion vectors, magnetic lineations, fracture zones, hot spots, and active volcanoes.

Summary and Plan for the Period September 1982 to June 1983

Addicott summarized the objectives and agreements for the nine-month period ending in June 1983. Headquarters will distribute photographic copies of the three color proofs (Northeast Geologic, Southeast Geologic, and Northeast Mineral Resources Map sheets) to the panel chairmen and principal authors in September 1982 for review and corrections. Another color proof of each of the two Geologic Map sheets will be made before the end of 1982. The target for printing these maps will be early in 1983. Late this year, cartographic work on the Antarctica and Southwest Quadrant Geologic Map sheets will begin. McCoy committed to complete the sea-floor-sediment mapping of the Antarctica Sheet by mid-November.

Shortly after the meeting the Tectonic Map compilation guidelines will be mailed to the panel chairmen for study and approval. This, Addicott said, would allow sufficient time for each of the panels, other than the Southwest Panel, to prepare preliminary compilations for the June 1983 Map Project meeting. Final compilation of the Southwest Quadrant Tectonic Map sheet will be completed by Scheibner prior to the 1983 meeting. Terman observed that the SOPAC and Southwest Quadrant Panel meetings to be held in Wellington, New Zealand, in November, and the CCOP and Northwest Quadrant Panel meetings to be held in Tokyo, Japan, in December, would serve as review opportunities for the compilation guidelines. Addicott observed that with the guidelines firmly in place and the scheduled completion of final compilations of all of the Geologic Map sheets by January 1, 1983, the Tectonic Map Series would become the next thematic map series to be published.

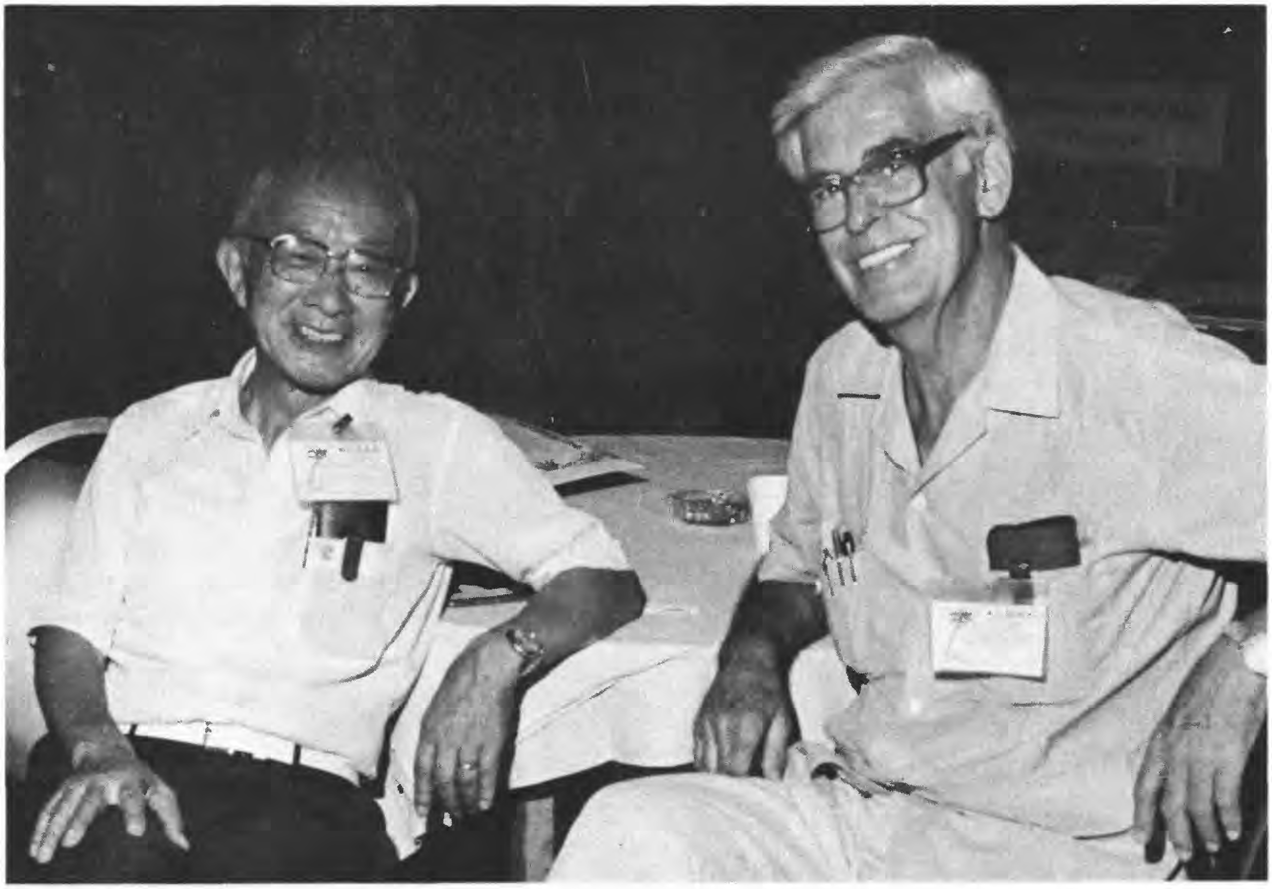

Figure 18. Chikao Nishiwaki (left), Northwest Quadrant Panel Chairman, and Philip W. Guild (right), Mineral Resources Map Advisor, at Interim Meeting of Map Project, Honolulu, Hawaii, August 22, 1982.

Publication of the Mineral Resources Map Series will begin in 1983 with the Northeast Quadrant Map, following completion of another color proof late this year (1982). The Southeast Quadrant Map should be finalized by the end of this year and a color proof made during 1983.

Corrections and additions to the Energy Resources Map sheets of the Northeast and Southeast Quadrants are targeted for completion during 1983. The panel chairmen for each of these quadrants will take over responsibility for revision of these maps; headquarters will obtain heatflow spot data and will add sea-floor sediment and sediment-thickness isopachs for the oceanic areas.

Terman will obtain SEASAT gravity-anomaly mapping, geoid-anomaly mapping, magnetic-anomaly mapping, and crustal-thickness mapping, all for inclusion in the Geodynamics Map Series. These data sets will be coordinated and printed onto the Northeast Quadrant base for study by the map committee at the June 1983 project meeting.

References Cited

Addicott, W. O., 1980, Status of the Circum-Pacific Map Project, a summary of the Circum-Pacific Map Project meeting in Menlo Park, California, May 6-8, 1980: U.S. Geological Survey Open-File Report 80-1059, 77 p.

---------- 1981a, Map series links plates and resources: Geotimes, v. 26, p. 19-21.

---------- 1981b, Mapping half the world: Episodes, v. 1981, p. 48-49.

---------- 1981c, Circum-Pacific Map Project update: American Association of Petroleum Geologists Explorer, v. 2, p. 16.

Bates, R. L., and J. A. Jackson, eds., 1980, Glossary of geology: Falls Church, American Geological Institute, 749 p.

Bhandari, L. L., A. T. R. Raju, A. K. Datta, and A. N. Chaube, 1975, Oil and natural gas map of Asia, second edition: United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), scale 1:5,000,000.

Burnett, W. C., and A. I . N. Lee, 1980, The phosphate supply system in the Pacific region: GeoJournal, v. 4, p. 423-436.

Coney, P. J., D. L. Jones, and J. W. H. Monger, 1980, Cordilleran suspect terranes: Nature, v. 288, p. 329-333.

Corvalãn D., J., 1981, Plate-Tectonic Map of the Circum-Pacific Region, Southeast Quadrant: American Association of Petroleum Geologists, scale 1:10,000,000.

---------- 1982, Southeast Quadrant mapping: Circum-Pacific Map Project: American Association of Petroleum Geologists Bulletin, v. 67, p. 962.

Coury, A. B., and T. A. Hendricks, 1978, Map of prospective hydrocarbon provinces of the world: U.S. Geological Survey Miscellaneous Field Studies Maps MF-1044A and MF-1044C, scale 1:20,000,000.

Craddock, C., 1981, Plate-Tectonic Map of the Circum-Pacific Region, Antarctica Sheet: American Association of Petroleum Geologists, scale 1:10,000,000.

---------- 1982, Geologic map of Antarctica: American Association of Petroleum Geologists Bulletin, v. 67, p. 962-963.

Doutch, H. F., 1981, The Circum-Pacific Map Project: Australian Geologist, p. 5-7.

---------- 1981, Plate-Tectonic Map of the Circum-Pacific Region, Southwest Quadrant: American Association of Petroleum Geologists, scale 1:10,000,000.

---------- 1982, Status of Circum-Pacific Map Project--Southwest Quadrant, mid-1982: American Association of Petroleum Geologists Bulletin, v. 67, p. 964.

Drummond, K. J., 1981, Plate-Tectonic Map of the Circum-Pacific Region, Northeast Quadrant: American Association of Petroleum Geologists, scale 1:10,000,000.

---------- 1982, Northeast Quadrant mapping, Circum-Pacific Map Project: American Association of Petroleum Geologists Bulletin, v. 67, p. 965.

Drummond, K. J., C. Nishiwaki, J. Corvalân D., H. F. Doutch, and C. Craddock, 1982, Plate-Tectonic Map of the Circum-Pacific Region, Pacific Basin Sheet: American Association of Petroleum Geologists, scale 1:20,000,000.

Eister, M. F., 1982, The year in review: mapping: Geotimes, v. 27, p. 45.

Golovchenko, X., R. L. Larson, and W. C. Pitman, III, 1982, Magnetic lineations: Plate-Tectonic Map, Circum-Pacific Region, Pacific Basin Sheet: American Association of Petroleum Geologists, scale 1:20,000,000.

Guild, P. W., 1981, Preliminary metallogenic map of North America; a numerical listing of deposits: U.S. Geological Survey Circular 858-A, 93 p.

Guild, P. W., and M. P. Lee, 1982, Circum-Pacific Minerals Maps: American Association of Petroleum Geologists Bulletin, v. 67, p. 970.

Halbouty, M. T., ed., 1981, Energy resources of the Pacific region: American Association of Petroleum Geologists Studies in Geology 12, 578 p.

Halbouty, M. T., J. C. Maher, H. M. Lian, eds., 1976, Circum-Pacific Energy and Mineral Resources, papers from the Circum-Pacific Energy and Mineral Resources Conference held August 26-30, 1974, in Honolulu, Hawaii: Tulsa, Oklahoma, American Association of Petroleum Geologists, 608 p.

Hoover, L., 1982, The year in review: international: Geotimes, v. 27, p. 42-43.

International Association of Volcanology and Chemistry of the Earth's Interior, 1973, Data sheets of the post-Miocene volcanoes of the world with index map: Rome, D'Antimi, v. 1-22.

Jones, D. L., D. G. Howell, P. J. Coney, and J. W. H. Monger, 1983, Recognition, character, and analysis of tectonostratigraphic terranes in western North America: Japan Center for Academic Publications, Oji Seminar v. (in press).

Jones, D. L., D. G. Howell, and E. R. Schermer, 1982, Preliminary tectonostratigraphic terrane map of Circum-Pacific Region: American Association of Petroleum Geologists Bulletin, v. 67, p. 972.

Jones, D. L., N. J. Silberling, H. C. Berg, and G. Plafker, 1981, Tectonostratigraphic terrane map of Alaska: U.S. Geological Survey Open-File Report 81-792, scale 1:2,500,000.

Ludwig, W. C., and R. E. Houtz, 1979, Isopach map of sediments in the Pacific Ocean basin and marginal sea basins: American Association of Petroleum Geologists, scale 1:13,999,369.

McCoy, F. W., 1981, New surface-sediment distribution maps for Pacific Ocean: American Association of Petroleum Geologists Bulletin, v. 65, p. 956.

---------- 1982, New surficial sediments of Pacific Ocean: Circum-Pacific Map Project (1:10,000,000): American Association of Petroleum Geologists Bulletin, v. 67, p. 976.

McKelvey, V. E., 1982, Implications of Law of the Sea: Geotimes, v. 27, p. 21-22.

Minster, J. B., and T. H. Jordan, 1978, Present-day plate motions: Journal of Geophysical Research, v. 83, p. 5331-5345.

Monger, J. W. H., and R. A. Price, 1979, Geodynamic evolution of the Canadian Cordillera--progress and problems: Canadian Journal of Earth Sciences, v. 16, p. 770-791.

Monger, J. W. H., R. A. Price, and D. J. Templeman-Kluit, 1982, Tectonic accretion and the origin of the two major metamorphic and plutonic welts in the Canadian Cordillera: Geology, v. 10, p. 70-75.

Moore, G. W., 1982, Plate-Tectonic Map of the Circum-Pacific Region, explanatory notes: Tulsa, Oklahoma, American Association of Petroleum Geologists, 14 p.

Nishiwaki, C., 1981, Plate-Tectonic Map of the Circum-Pacific Region, Northwest Quadrant: American Association of Petroleum Geologists, scale 1:10,000,000.

Nishiwaki, C., T. Nozawa, and Y. Shimazaki, 1982, Status of geologic and resources mapping, Northwest Quadrant, Circum-Pacific Map Project: American Association of Petroleum Geologists Bulletin, v. 67, p. 978-979.

North American Metallogenic Map Committee, 1981, Preliminary metallogenic map of North America: U.S. Geological Survey, scale 1:5,000,000.

Piper, D. Z., T. R. Swint, V. E. McKelvey, and L. Sullivan, 1982, Distribution of manganese nodules in Pacific Ocean: American Association of Petroleum Geologists Bulletin, v. 67, p. 980-981.

Reinemund, J. A., W. O. Addicott, and P. W. Guild, 1982, Circum-Pacific Map Project: framework for international resources assessment: American Association of Petroleum Geologists Bulletin, v. 67, p. 982.

Richards, P. W., 1979, Status of the Circum-Pacific Map Project, a summary of the Circum-Pacific Map Project meeting in Menlo Park, California, May 2-4, 1979: U.S. Geological Survey Open-File Report 79-1561, 38 p.

St. John, W., 1980, Sedimentary basins of the world and giant hydrocarbon accumulations: Tulsa, Oklahoma, American Association of Petroleum Geologists, 23 p., map scale 1:40,000,000.

Scheibner, E., 1982, Tectonic Map of the Circum-Pacific Region, Southwest Quadrant, a draft presentation, <u>in</u> Abstracts of papers by participants in the Circum-Pacific Conference on Energy and Mineral Resources, Honolulu, Hawaii, August 23-27, 1982: Menlo Park, Circum-Pacific Council for Energy and Mineral Resources, Circum-Pacific Map Project, p. 18-19.

Simkin, T., L. Siebert, L. McClelland, D. Dubridge, C. Newhall, and J. H. Latter, 1981, Volcanoes of the world, a regional directory, gazetteer, and chronology of volcanism during the last 10,000 years: Stroudsburg, Pennsylvania, Hutchison Ross, 236 p.

Swint, T. R., and P. W. Richards, 1983, Deep Sea Drilling Project columnar sections: Geologic Map of the Circum-Pacific Region, Northeast Quadrant: American Association of Petroleum Geologists, scale 1:10,000,000 (in press).

Watts, A. B., 1975, Gravity field of the Northwest Pacific Ocean basin and its margin: Aleutian Island arc-trench system: Geological Society of America Map and Chart Series MC-27, scale 1:3,000,000.

Watts, A. B., C. O. Bowin, and J. H. Bodine, 1978a, Free-air gravity field, in Hayes, D. E., compiler, A geophysical atlas of the east and southeast Asian seas: Geological Society of America Map and Chart Series MC-25, scale 1:6,442,194.

Watts, A. B., M. B. Kogen, J. Mutter, G. D. Garner, and F. J. Davey., 1981, Free-air gravity field of the southwest Pacific Ocean: Geological Society of America Map and Chart Series MC-42, scale 1:4,500,000.

Watts, A. B., J. B. Kogen, and J. H. Bodine, 1978b, Gravity field of the Northwest Pacific Ocean basin and its margin: Kuril Island arc-trench system: Geological Society of America Map and Chart Series MC-27, scale 1:3,000,000.

Watts, A. B., and M. Talwani, 1975, Gravity field of the Northwest Pacific Ocean basin and its margin: Hawaii and vicinity: Geological Society of America Map and Chart Series MC-9, scale 1:3,937,000.

Wilford, G. E., 1981, Petroleum and oil shale: Australia Bureau of Mineral Resources Earth Science Atlas, scale 1:10,000,000.

Table 1. Preparation status of unpublished Circum-Pacific 1:10,000,000-scale thematic maps as of October 1982.

Map	Element		Quadrant/Status				
			NW	SW	AN	SE	NE
GEOLOGIC	Rock units	Panels	+	+	[+]	[ ]	[ ]
	Sea-floor sediment	Hdqs.	[+]	[+]	+	[ ]	[ ]
	DSDP sites	Hdqs.	[+]	[+]	+	[ ]	[ ]
	Selected columnar sections	Hdqs.	[+]	+	+	[ ]	[ ]
	Geology of ocean areas	H/P	-	-	-	[ ]	[ ]
	Faults	Panels	+	+	[+]	[ ]	[ ]
	Explanatory text	H/P		-		[+]	[+]
TECTONIC	Tectonic units	Panels	+	+	+	+	+
	Folds	Panels	-	+	-	-	-
	Faults, incl. historic & post-Miocene	Panels	-	-	-	-	-
	Active plate boundaries	H/P	[ ]	[ ]	[ ]	[ ]	[ ]
	Isopachs, sea-floor sediment	Hdqs.	[+]	[+]	[+]	[+]	[+]
	Isopachs, land areas	Panels	-			-	-
	Salt domes, areas of	Panels					-
	Diatremes, crypto-explosion structures	Panels					
	Age of oceanic crust	Hdqs.	[+]	[+]	[+]	[+]	[+]
	Geochronologic data (rock ages)	Panels					
	Paleomagnetic data	Panels					
	Crustal thickness (inset map)	Panels					-

Map	Element		Quadrant/Status				
			NW	SW	AN	SE	NE
TECTONIC	Accreted terranes (inset map)	Panels					+
	Continental/oceanic crust boundary	Hdqs.	[ ]	[ ]	[ ]	[ ]	[ ]
	Explanatory text	Panels					
GEODYNAMICS	Volcanoes, Holocene	Hdqs.	[ ]	[ ]	[ ]	[ ]	[ ]
	Focal mechanisms	Hdqs.	[ ]	[ ]	[ ]	[ ]	[ ]
	Gravity, sea areas	Hdqs.	-	-	-	-	-
	Gravity, land areas	Panels	-	-			-
	Lithospheric stress	Panels	-				-
	Seismic epicenters	Hdqs.	[ ]	[ ]	[ ]	[ ]	[ ]
	Active plate boundaries	Hdqs.	[ ]	[ ]	[ ]	[ ]	[ ]
	Geoid anomalies	Hdqs.					
	Magnetic anomalies	Hdqs.					
	Crustal thickness	Hdqs.					
	Explanatory text	Panels					
MINERAL RESOURCES*	Mineral localities on land	Panels	-			+	[ ]
	Sea-floor mineral data	Hdqs.	+	[+]	[+]	[+]	[ ]
	Geologic/tectonic background	Panels	-	-	-	+	[ ]
	Sea-floor sediment	Hdqs.	[+]	[+]	+	[ ]	[ ]
	Explanatory text	H/P					-

Map	Element		Quadrant/Status				
			NW	SW	AN	SE	NE
ENERGY RESOURCES	Oil and gas fields	Panels		-		[ ]	[ ]
	Oil shale, tar sands	Panels		-		[ ]	[ ]
	Coal-bearing areas	Panels	-	-		[ ]	[ ]
	Isopachs, land areas,	Panels	-			[ ]	[ ]
	Isopachs, sea-floor sediment	Hdqs.	[+]	[+]		[+]	[+]
	Selected stratigraphic columns	Panels					
	Heatflow, spot data	Panels	-				
	Geothermal sites	Panels	-				
	Explanatory text	Panels					

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not compiled or compilation status unknown.

- partially compiled

+ some material submitted to project hdqs.

[+] completed and submitted to project hdqs.

[ ] cartography completed

* Energy and Minerals Maps for Antarctica to be combined

Table 2. Members of the five regional panels of the Circum-Pacific Map Project and map consultants.

Panel Members

NORTHWEST QUADRANT

Chairman:	
CHIKAO NISHIWAKI	Japan
Zhang Wen-you	China
Li Yin-huai	China
Ismet Akil	Indonesia
H. M. S. Hartono	Indonesia
Fred Hehuwat	Indonesia
Yutaka Ikebe	Japan
Yasufumi Ishiwada	Japan
Hisao Kuwagata	Japan
Tomoyuki Moritani	Japan
Tamotsu Nozawa	Japan
Hokuichiro Ohmachi	Japan
Tadashi Sato	Japan
Konosuki Sawamura	Japan
Y. Shimazaki	Japan
Masatoshi Sogabe	Japan
Yoji Teraoka	Japan
Seiya Uyeda	Japan
Takashi Yoshida	Japan
S. K. Chung	Malaysia
Dominador H. Almogela	Philippines
Guillermo R. Balce	Philippines
Oscar A. Crispin	Philippines
Juanito C. Fernandez	Philippines
Froilan Gervasio	Philippines
Chong Su Kim	Rep. of Korea
No Young Park	Rep. of Korea
Donald L. Zieglar	SEAPEX*
Sangad Bunopas	Thailand
Phisit Dheeradilok	Thailand
Kaset Pitakpaivan	Thailand
Michael Churkin	USA
Maurice J. Terman	USA
Frank F. H. Wang	USA
L. I. Krasny	USSR
V. B. Kurnosov	USSR
V. G. Moiseenko	USSR
N. A. Shilo	USSR

*Southeast Asia Petroleum Exploration Society

SOUTHWEST QUADRANT

Chairman:	
H. F. DOUTCH	Australia
R. N. Richmond	APEA*
J. N. Casey	Australia
N. Exon	Australia
D. Falvey	Australia
W. Johnson	Australia
D. Palfreyman	Australia
E. Scheibner	Australia
P. Wellman	Australia
L. Machesky	ESCAP
P. Rodda	Fiji
J. G. Paris	New Caledonia
J. Recy	New Caledonia
H. R. Katz	New Zealand
K. Doble	Papua New Guinea
S. Danitofea	Solomon Islands
A. MacFarlane	Vanuatu

*Australia Petroleum Exploration Association

ANTARCTICA REGION

Chairman:	
CAMPBELL CRADDOCK	USA
R. L. Oliver	Australia
Oscar Gonzâlez-Ferran	Chile
Raymond J. Adie	Great Britain
G. W. Grindley	New Zealand
Charles R. Bentley	USA
David H. Elliot	USA
Arthur B. Ford	USA
Dennis E. Hayes	USA
G. E. Grikurov	USSR

SOUTHEAST QUADRANT

Chairman:

JOSE CORVALAN	Chile
Vicente H. Padula	Argentina
Carlos Salinas	Bolivia
Eduardo Gonzáles P.	Chile
Alfredo Lahsen A.	Chile
Carlos Mordojovich	Chile
Jaime Cruz	Colombia
Hermann Duque-Caro	Colombia
Michel Hermelin	Colombia
Rodrigo Alvarado	Ecuador
H. G. Barsczus	France
Eleodoro Bellido B.	Peru
Alberto Giesecke	Peru
Jose Lizzárraga R.	Peru
Fernando Zuñiga	Peru
George E. Ericksen	USA
J. Erick Mack, Jr.	USA
Alirio Bellizzia B.	Venezuela
José Antonio Galavis	Venezuela
Henrique J. Lavie	Venezuela
Cecilia Martín B.	Venezuela

NORTHEAST QUADRANT

Chairman:	
KENNETH J. DRUMMOND	Canada
R. L. Chase	Canada
Kenneth M. Dawson	Canada
Hubert Gabrielse	Canada
Geoffrey B. Leech	Canada
Samuel Bonis	Guatemala
Gabriel Dengo	Guatemala
Oscar D. Salazar	Guatemala
G. P. Salas	Mexico
James E. Case	USA
George Gryc	USA
Philip W. Guild	USA
L. D. Kulm	USA
Allen Lowrie	USA
Ray G. Martin	USA
Ralph Moberly	USA
George W. Moore	USA
David W. Scholl	USA
Peter R. Vail	USA

Consultants

MAP COORDINATION CONSULTANTS

Xenia Golovchenko	Marine Magnetics
Philip W. Guild	Minerals
George W. Moore	Marine Geology
David Z. Piper	Marine Minerals
Paul W. Richards	Energy
Arthur C. Tarr	Seismology
Tom Simkin	Volcanology
Anthony B. Watts	Gravity
Jacqueline Mammerickx Winterer	Bathymetry

MAP INFORMATION CONSULTANTS

Allen L. Clark
Paul C. Bateman
Larry C. Bonham
James A. Calkins
Thomas E. Chase
Robert G. Coleman
Hugo Cortês G.
Paul J. Grim
Trowbridge Grose
Douglas M. Kinney
Philip L. Lawrence
Robert R. Mallis
James Marsh
Frederick J. Mauk
Herbert Meyers
Richard H. Rapp
Roberto Sarmiento
Stuart Smith
Frank F. H. Wang

SPECIAL CONSULTANTS

John P. Albers (U.S. Geological Survey)
Thomas A. Davies (International Program for Ocean Drilling)
Edward M. Davin (International Decade of Ocean Exploration)
Frances Delany (Commission for the Geological Map of the World)
L. D. Kulm (Oregon State University)
Roger L. Larson (University of Rhode Island)
C. Y. Li (East-West Center)
Floyd W. McCoy (Lamont-Doherty Geological Observatory)
Vincent E. McKelvey (U.S. Geological Survey)
Herbert W. Meyers (National Geophysical Data Center)
William A. Nierenberg (Scripps Institution of Oceanography)
Dallas L. Peck (U.S. Geological Survey)
Walter C. Pitman III (Lamont-Doherty Geological Observatory)
Tom Simkin (U.S. National Museum)
Eric E. W. Simpson (International Oceanographic Commission)
Lawrence W. Sullivan (Lamont-Doherty Geological Observatory)
Manik Talwani (GMF Research and Development Company)
Anthony B. Watts (Lamont-Doherty Geological Observatory)
A. I. Zhamoida (All Union Geological Institute, U.S.S.R.)

Table 3. Organizations cooperating with or providing information for the Circum-Pacific Map Project.

Governmental Agencies

Argentina Servicio Nacional Minero Geológico
Australia Bureau of Mineral Resources (BMR)
Bangladesh Geological Survey
Bolivia Yacimientos Petrolíferos Fiscales
Centre Oceanologique du Pacifique/Centre National pour l'Exploration des Oceans (COP/CNEXO), Tahiti
Chile Instituto de Investigaciones Geológicas
Colombia Instituto Nacional de Investigaciones Geológico Mineras
Cook Islands Department of Survey and Physical Planning
Ecuador Departamento de Geología y Minería
Fiji Mineral Resources Department
Geological Survey of Canada
Geological Survey of Japan
Guatemala Instituto Geográfico Nacional
Indonesia Geological Survey
Indonesia Ministry of Mines
Kiribati Ministry of Natural Resources Development
Korea Research Institute for Geosciences and Mineral Resources
Malaysia Federal Geological Survey
Mexico Consejo de Recursos Minerales
New Caledonia Bureau de Recherche Geologique et Minieres
New South Wales Geological Survey, Australia
New Zealand Geological Survey
Office de la Recherche Scientifique et Technique d'Outre Mer (ORSTOM) Centre, New Caledonia
Office de la Recherche Scientifique et Technique d'Outre Mer (ORSTOM), Tahiti
Papua New Guinea Geological Survey
Perú Oficina Nacional de Evaluación de Recursos Naturales
Perú Servicio de Geología y Minería
Philippine Bureau of Mines, Department of Agricultural and Natural Resources
Servicio Geológico de Bolivia
Smithsonian Institution
Solomon Islands Ministry of Natural Resources
Thailand Department of Mineral Resources
Tonga Lands, Surveys, and Natural Resources Department
Trust Territories of the Pacific, Resources and Development Department
U.S. Board of Geographic Names
U.S. Defense Mapping Agency
U.S. Department of Energy
U.S. Geological Survey
U.S. National Aeronautic and Space Administration (NASA)

U.S. National Geophysical Data Center
U.S. National Oceanographic and Atmospheric Administration (NOAA)
U.S. Naval Oceanographic Office
Vanuatu Geological Survey
Venezuela Ministerio de Energía y Minas

Institutes

All-Union Geological Institute (VSEGEI) (USSR)
Apia Observatory, Cook Islands
Earthquake Research Institute, University of Tokyo
Far East Geological Institute, Vladivostok, USSR
Geological Institute, Academia Sinica
Geological Institute of Mines and Metallurgy, Peru
Geophysical and Polar Research Center, University of Wisconsin
Hawaii Institute of Oceanography
Institute of Arctic Geology, Ministry of Geology of the USSR
Institute of Geological Sciences, United Kingdom
Institute of International Mineral Resources Development
Institute of Polar Studies, Ohio State University
Instituto de Geográfico Nacional de Guatemala
Lamont-Doherty Geological Observatory
National Institute of Geology and Mining, Indonesia
New Zealand Oceanographic Institute
Pan American Institute of History and Geography (PAIGH)
Resources Systems Institute, East-West Center
Far East Center of the USSR Academy of Sciences
Scott Polar Research Institute, Cambridge
Scripps Institution of Oceanography

Universities

Arizona State University
Australian National University
Colorado School of Mines
Columbia University
Escuela Politecnica Nacional, Ecuador
Florida State University
Johns Hopkins University
Kobe University
Imperial College of Science and Technology, London
Michigan State University
Middlebury College
Ohio State University
Oregon State University, School of Oceanography
Stanford University
State University of New York (SUNY), Albany
Texas Technical University
Tsukuba University
Universidad de Argentina

Universidad de Chile
University of Adelaide, Australia
University of California, Santa Cruz
University of Capetown, South Africa
University of Michigan
University of Rhode Island
University of Singapore
University of Sydney
University of the South Pacific, Kiribati
University of Texas
University of Western Australia
University of Wisconsin

Companies

Atlantic-Richfield Oil Company (ARCO)
Chevron Overseas Petroleum, Inc.
Esso Exploration, Inc.
Exxon Production Research Co.
Gulf Research and Development Company
Japan Petroleum Exploration Company (JAPEX)
Kennecott Exploration Inc.
Marathon Oil Company
Mobil Oil Company, Canada
Pertamina
Petróleos del Perú
Union Oil Company of California

Commissions and Societies

American Association of Petroleum Geologists (AAPG) (publisher)
ASEAN Council on Petroleum (ASCOPE)
Australian Petroleum Exploration Association (APEA)
Centro Regional de Seismología para America del Sur (CERESIS)
Circum-Pacific Council for Energy and Mineral Resources
Commission for the Geologic Map of the World (CGMW)
Deep Sea Drilling Project (DSDP)
General Bathymetric Chart of the Oceans (GEBCO), a project of the International Oceanographic Commission (IOC) and the International Hydrographic Organization (IHO)
Geological Society of America
Intergovernmental Oceanographic Commission (IOC) Central Editorial Board for Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
International Decade of Ocean Exploration (IDOE)
International Geodynamics Project
International Geological Correlation Programme
International Program for Ocean Drilling (IPOD)
International Union of Geological Sciences
Pacific Science Association

Scientific Committee on Oceanic Research (SCOR), International Council of Scientific Unions
Southeast Asia Petroleum Exploration Society (SEAPEX) (NW Panel Membership)
United Nations Asia and Pacific Branch
United Nations Economic and Social Commission for the Pacific, Natural Resources Division/(ESCAP)
United Nations Committee for Co-ordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas (CCOP)
United Nations Committee for Co-ordination of Joint Prospecting for Mineral Resources in South Pacific Offshore Areas (CCOP/SOPAC)
United Nations Environmental Program (UNEP)
United Nations Mineral Prospecting Branch
United Nations Ocean Economics and Technology Branch
Volcanological Society of Japan
World Data Center A, Boulder, Colorado

Summary:

The 134 organizations in this listing are categorized as follows:

Governmental agencies	45
Institutes	20
Universities	30
Companies	12
Commissions and societies	27
Total	134

These organizations represent 39 different countries or protectorates. A few additional countries are believed to have contributed directly to the regional panels, but are not known to headquarters. There are some 20 cooperating international organizations not identifiable with any one country. About one-third of the organizations are from the United States.

Countries, including island nations and protectorates, that have contributed to this work in one way or another include:

Argentina
Australia
Bangladesh
Bolivia
Brazil
Canada
Chile
Colombia
Cook Islands
Ecuador
Fiji
French Polynesia (Tahiti)
Guatemala
Indonesia
Japan
Kiribati
Korea
Malaysia
Mexico
New Caledonia
New Zealand
Papua New Guinea
Paraguay
People's Republic of China
Peru
Philippines
Singapore
Solomon Islands
South Africa
Thailand
Tonga
Trust Territories of the Pacific Islands
USSR
United Kingdom
USA
Uruguay
Vanuatu
Venezuela
Western Samoa

Table 4. Persons in attendance at the opening session and congressional and press briefing held at the National Academy of Sciences, Washington, D.C., May 10, 1982.

Alfaro, A. M.
Philippine News Agency

Blau, Edward C.
Office of Rep. James Weaver
1226 Longworth House Office Bldg
Washington, D.C. 20515

Blau, Peter
Petroleum Information Corporation

Boggs, Danny J.
White House
227 Old EOB
Washington, D.C. 20500

Bottcher, Fred
German General News Service

Bustamante, Raul
IPESA Consultores
Mexico D.F., Mexico

Chase, Deborah R.
American Metal Market

Cochran, Wendell
Geotimes
5205 Leesburg Pike
Falls Church, Virginia 22041

Cook, Charles
American Mining Congress Journal

Corvalân, Josê
Departmento de Geología
Universidad de Chile
Casilla 13518, Correo 21
Santiago, Chile

Craddock, Campbell
Department of Geology and Geophysics
University of Wisconsin
Madison, Wisconsin 53706

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Comm. Geol. Map of the World
51, Blvd. Montmorency
74016 Paris, France

Desjardines, Corinne
Earth Science

Doutch, H. F.
Bureau of Mineral Resources
Box 378
Canberra City, A.C.T. 2601
Australia

Drummond, Kenneth
Mobil Oil Co. of Canada
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Toronto, Ontario
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Frasca, Tim
Pacific/Alaska News Nightly

Guild, Philip
U.S. Geological Survey
National Center Bldg, MS 952
Reston, Virginia 22092

Hager, Mary
Newsweek

Hatch, Anthony
ARCO
515 S. Flower St.
Los Angeles, California 90071

Jennrich, John
Oil & Gas Journal

Kelley, Donovan E.
U.S. Geological Survey
National Center Bldg, MS 119
Reston, Virginia 22092

Kinney, Douglas
Geological Survey Associates, Inc.
Box 30123
Bethesda, Maryland 20014

Kitabatake, Kasumi
The Mainichi Newspaper (Tokyo)

Kover, Allan
U.S. Geological Survey
National Center Bldg, MS 906
Reston, Virginia 22092

Lachica, Ed
Asian Wall Street Journal
1025 Connecticut Avenue NW
Washington, D.C. 20036

Lee, Michael
U.S. Geological Survey
National Center Bldg, MS 920
Reston, Virginia 22092

Lemley, Brad
National Public Radio

Lopez, Francis X.
U.S. Geological Survey
National Center Bldg, MS 917
Reston, Virginia 22092

Ludwigson, John
Independent Science Writer

Mack, J. Erick, Jr.
Union Oil Co. of California
461 S. Boylston St.
Los Angeles, California 90017

McKee, Sam
National Academy of Sciences
2101 Constitution Avenue
Washington, D.C. 20008

Moore, George W.
U.S. Geological Survey
345 Middlefield Road, MS 99
Menlo Park, California 94025

Murphy, Marvin
The Oil Daily

Nevill, Hugh
New Zealand Press Association

Nishiwaki, Chikao
2-8-8, Nishinogawa
Komae-shi
Tokyo 201, Japan

Nozawa, Tamotsu
Geological Survey of Japan
1-1-3, Higashi, Yatabe
Ibaraki 305, Japan

Palomo, Anthony
Office of Assistant Secretary
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International Affairs
U.S. Department of Interior
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Menlo Park, California 94025

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Rossiter, Al
United Press International

Schmid, Randolph E.
The Associated Press
2021 K St. NW
Washington, D.C. 20036

Shaffer, Karen A.
Minority Counsel
House Mines and Mining Subcommittee
House Annex No. 1
Washington, D.C. 20515

Sidlauskas, Frank
U.S. Geological Survey
National Center Bldg, MS 917
Reston, Virginia 22092

St. George, Robert
United Press International

Summers, Robert A.
Office of International Affairs
U.S. Department of Energy
Washington, D.C. 20585

Terman, M. J.
U.S. Geological Survey
National Center Bldg, MS 917
Reston, Virginia 22092

Ternes, Alan
Natural History Way
New York, New York 10024

Walker, Alta
U.S. Geological Survey
National Center Bldg, MS 731
Reston, Virginia 22092

Yoshida, Masao
NHK (Japan Broadcasting Corp.)
4-20-2 Nakamura-kita
Nerima-ku
Tokyo, Japan

Table 5. Participants in the Circum-Pacific Map Project meeting, Reston, Virginia, May 11-13, 1982.

Addicott, Warren O.
U.S. Geological Survey
345 Middlefield Road, MS 52
Menlo Park, California 94025

Bergin, Marion J.
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National Center Bldg, MS 917
Reston, Virginia 22092

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Craddock, Campbell
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Delany, Frances
Secretary General
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Dilonardo, Peter
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Table 6. Sales of Circum-Pacific Maps, 1978-1982*

	1978-1979	1980	1981	1982	Total
NW Geographic	615	40	53	419	1127
NW Base Map	263	24	36	290	613
NW Plate-Tectonic	---	---	---	1035	1035
NE Geographic	434	57	77	438	1006
NE Base Map	196	25	38	352	611
NE Plate-Tectonic	---	---	90	1330	1420
SW Geographic	112	66	71	403	652
SW Base Map	43	34	41	289	407
SW Plate-Tectonic	---	---	---	924	924
SE Geographic	156	52	56	382	646
SE Base Map	74	25	31	279	409
SE Plate-Tectonic	---	---	86	1058	1144
Antarctica Geog.	64	52	62	372	550
Antarctica Base Map	29	19	28	273	349
Antarctica Plate-Tectonic	---	---	---	832	832
Total Area Geog.	78	70	68	400	616
Total Area Base Map	3	32	33	267	335
Total Area Plate-Tectonic	---	---	---	1	1

*Yearly sales totals reflect the number of maps sold between July 1 of the previous year and June 30 of the year listed.

LAND RESOURCES

Commodities Shown by shape and color of symbol.

	●	■	◆	♦	◆ (horizontal)
red	● W	■ Sn	◆ Sn W	♦ Be	◆ Nb(Ta)U
orange	● Cu(AuAg)	■ Mo	◆ CuMo	♦ CuZn(PbAgAu)	◆ CuNi
yellow	● Au(Ag)	■ Ag(PbZnCuAu)	◆ AuAg, AgAu	♦ Precious gems	◆ Semi-precious gems
yellow green	● S	■ FeS	◆ Nitrate	♦ Li	◆ B
green	● Cr	■ Ni(CoCuPt)	◆ Co(Ni)	♦ Pt group	◆ Asbestos
blue green	● Na	■ K		♦ Gypsum-anhydrite	◆ Magnesite
blue	● Pb	■ Zn	◆ PbZn, ZnPb	♦ PbZn(AgCuAu)	
heliotrope	● Hg	■ Sb	◆ F	♦ Ba	◆ Sr
light brown	● U	■ V	◆ UV, VU	♦ RETh	◆ Al
dark brown	● Fe	■ Mn	◆ Ti	♦ FeTi(V)	◆ P

Outline of extensive district

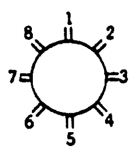
Deposit size By size of symbol. Limits in metric tons of metal or mineral contained unless otherwise specified. Past production and(or) reserves totaled.

Size	O Large	>	o Medium	>	∘ Small
Aluminum (bauxite)		100,000,000		1,000,000	
Antimony		50,000		5,000	
Asbestos		10,000,000		100,000	
Barite ($BaSO_4$)		5,000,000		50,000	
Beryllium (BeO)		1,000		10	
Boron (B_2O_3)		10,000,000		100,000	
Chromium (Cr_2O_3)		1,000,000		10,000	
Cobalt		20,000		1,000	
Copper		1,000,000		50,000	
Fluorite (CaF_2)		5,000,000		50,000	
Gold		500		25	
Graphite		1,000,000		10,000	
Gypsum-anhydrite		100,000,000		5,000,000	
Iron (ore)		100,000,000		5,000,000	
Lead		1,000,000		50,000	
Lithium (Li_2O)		100,000		10,000	
Magnesium ($MgCO_3$)		10,000,000		100,000	
Manganese (tons of 40% Mn)		10,000,000		100,000	
Mercury (flasks)		500,000		10,000	
Molybdenum		500,000		5,000	
Nickel		500,000		25,000	
Niobium-Tantalum (R_2O_5)		100,000		1,000	
Phosphate (P_2O_5)		200,000,000		200,000	
Platinum group		500		25	
Potassium (K_2O)		10,000,000		1,000,000	
Precious gems		10		1	
Pyrite (FeS_2)		20,000,000		200,000	
Rare earths (RE_2O_3)		1,000,000		1,000	
Semi-precious gems		100		10	
Silver		10,000		500	
Sodium (salts)		10,000,000		1,000,000	
Strontium (salts)		1,000,000		10,000	
Sulfur		10,000,000		100,000	
Thorium		10,000		1,000	
Tin		100,000		5,000	
Titanium (TiO_2)		10,000,000		1,000,000	
Tungsten		10,000		500	
Uranium		10,000		100	
Vanadium		10,000		500	
Zinc		1,000,000		50,000	

Deposit type Shown by tick(s) on basic symbol.

- Veins and shear-zone fillings
- Stratabound, including magmatic cumulates
- Stockworks, including "porphyry" deposits
- Magmatic and irregular massive deposits
- Skarn or greisen deposits
- Sandstone (red bed) deposits
- Laterite deposits (surficial chemical concentrations)
- Placer deposits (surficial mechanical concentrations)

Age of mineralization Geologic age of mineralization shown by double ticks on some deposits. Age known only as "not younger than" or "not older than" indicated by a hook on the age tick.



1. Precambrian
2. Cambrian-Middle Devonian
3. Late Devonian-Early Triassic
4. Middle Triassic-Jurassic
5. Cretaceous (except latest)
6. Latest Cretaceous-Eocene (Laramide)
7. Oligocene-Pliocene
8. Post-Tertiary

SEA-FLOOR RESOURCES

Manganese Nodules

Abundance data. Photographic station showing percent of sea floor covered by nodules (in black).

- 0%
- 0-1%
- 1-10%
- 10-25%
- 25-50%
- >50%

10 Abundance contour in percent

Occurrence data. Sediment cores used in conjunction with bottom photographs to estimate sea-floor coverage.

o Nodules absent

x Nodules present

Chemical data. Dredge or core samples of nodules or crusts.

+ >1.8% nickel plus copper (red)

+ 1.0-1.8% nickel plus copper (blue)

+ <1.0% nickel plus copper (green)

$+_{Co}$ >1.0% cobalt (purple)

$+_{Mn}$ >35% manganese (brown)

These data points were not used in estimating sea-floor coverage.

Outline of area for which nodule analyses average 1.8 percent or more nickel plus copper (red)

Other Sea-floor Deposits

Polymetallic sulfide occurrence

On sea floor

471 Sub-sea floor (in DSDP core)

Submarine hot spring

Phosphorite (brown)

Seamount occurrence

P Guano deposit

BACKGROUND INFORMATION

Correlation diagram for map legends. To include columns subject quadrant and overlapping quadrants (from Geologic Map Series).

Land geology. Colors and patterns suggest the essential nature of the rocks. Geologic ages are indicated, where feasible, by letters keyed to those in the Correlation Diagram (boundaries from Geologic Map Series).

(yellow)		Surficial deposits
(orange)	a, b, c	Essentially undeformed, principally subaerial volcanic rocks: a) felsic, b) intermediate to mafic, c) mafic
	a, b	Platform cover rocks of Phanerozoic ages: a) marine, b) continental
		Basinal and marginal deposits, slightly to strongly deformed
(a, light green) (b, dark green)	a, b	Deformed sedimentary and volcanic rocks of phanerozic age, unmetamorphosed or little metamorphosed: a) "miogeosynclinal", b) "eugeosynclinal"
(blue)		Metamorphic complexes: most are of Phanerozoic age
(purple)		Proterozoic sedimentary and volcanic rocks, in general not highly metamorphosed
(light brown)		Precambrian crystalline rocks
(red)	a, b, c	Intrusive igneous rocks of Phanerozoic age: a) felsic, b) intermediate to mafic, c) mafic
		Ultramafic rocks

Sea-floor sediment. Character of surficial sediment shown by pattern or color.

		Terrigenous gravel, sand, and silt
(brown)		Clay
(green)		Biosiliceous ooze, biosiliceous clay
(blue)		Calcareous ooze, calcareous clay

(red) Active plate boundaries

(thick line)	Spreading axis
(thin line)	Transform fault
(line with triangles)	Subduction zone

Table 8. Topic outline for explanation to accompany Mineral Resources Map of the Northeast Quadrant.

Abstract

Introduction

Base map and scale; general statement about Map Project and map series.

Map content, with emphasis mainly on deposits but some information should be included that relates to genesis and that may help in further prospecting. Fossil fuels and construction materials excluded.

Land Geology

Describe main elements of explanation; mention geologic map as main source.

Land resources

Describe main elements of explanation and methodology (e.g., discuss meaning of "small" deposit as related to selection of prospects to be shown or not shown). Refer to Preliminary Metallogenic Map of North America (Guild, 1981) as source and supplement.

Optional: Discuss at least main relations between occurrence and distribution of mineral deposits and geology as guides to prospecting. Possibly mention J. P. Albers' work as illustrative of use of the maps in defining favorable areas.

Beach placers

Describe explanation and main elements of distribution.

Sea-floor resources

Describe main elements of explanation. Mention geologic and plate-tectonic maps source and supplements of sea-floor geology. Describe methodology for determining nodule abundance and point out (with illustrative examples) that percent coverage cannot be converted to nodule concentration without information (not shown on the map) on nodule size.

Optional: Discuss main trends in regional distribution of sea-floor deposits and the apparent reasons for them--e.g., the relation of nodule abundance to areas of slow deposition, of Co-rich nodules to depth, of Ni+Co-rich nodules to high organic productivity and abyssal depth, of P deposits to upwelling, and of sulfide deposits to ridge hydrothermal activity.

Table 9. Compilation guidelines for the Tectonic Map Series.

INTRODUCTION

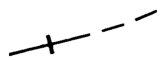
These guidelines result from: (1) a draft based on discussions on August 25, 1982 in Honolulu between M. J. Terman, E. Scheibner, H. F. Doutch, and G. W. Moore, and in part derived from earlier guidelines by M. J. Terman and E. Scheibner, and from a compilation of the Tectonic Map of the Southwest Quadrant presented by Scheibner to the August 1982 Map Project meeting in Honolulu; (2) discussions on the above draft by all panel chairmen except Campbell Craddock (Antarctica Region) on August 27, 1982 in Honolulu (Craddock supplied written comments); (3) review of all material by Scheibner and Doutch on September 24, 1982 in Sydney, Australia, resulting in some tidying up of the draft discussed on August 27, 1982 (footnotes are in response to panel chairmen's questions); and (4) review of (3) above by Terman, Scheibner, and Doutch on November 17, 1982 in Sydney.

The guidelines are designed primarily to enable quadrant compilers to show and contrast their information clearly. Cartographers are expected to have the final say about what symbols will be used on the published maps.

STRUCTURAL AND TECTONIC FEATURES (in black except as indicated)

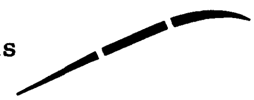
Plate boundaries and spreading centers: as on Plate-Tectonic Map.

Folds:

Anticlinal axis (gentle and open) 

Anticlinal axis (tight and closed) 

Selected synclinal axis 

Numerous folds 

Faults, fracture zone: extend from Geologic Map to include all faults; show displacement where known.

Normal (dip slip) 

Lateral (strike slip) 

Thrust (low angle) 

Reverse (high angle) 

Buried • • • • • •

Historic (red): displacement has occurred within the past 2000 years and is associated with recorded earthquakes or creep.

Post-Miocene (orange): displacement not associated with historic records, but recognized by scarps or water barriers in post-Miocene sediments, markedly linear mountain fronts, offset streams, or alignment of fault-caused depressions; entire fault should be shown in orange where local evidence indicates post-Miocene age.

Pre-Pliocene or unknown (black).

Volcanoes (to be recompiled by Smithsonian Institution, and added to the map at project headquarters):

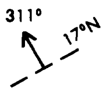
Dikes (if thought necessary): thin line with dots, all in green. If desired, annotate with lithologic term, abbreviated; e.g., dol (= dolerite).

Areas of salt domes: 

Diatremes, cryptoexplosion structures, kimberlite pipes, lamproites, and astroblemes: ⊕

Geochronologic data (rock ages): show at selected oceanic sites, particularly DSDP sites that reach oceanic basement, as K/Ar ages of basalt, or as paleontologic ages of overlying sedimentary rocks.

Paleomagnetic data: selected points, at which arrow shows azimuth of paleomagnetic north with respect to present true north. A dashed line normal to the tail of the arrow is labeled with value of paleolatitude and its geological age.



Depth to basement rocks or specified horizon: show indirectly by isopach lines (1, 3, 5 km) for continental areas to foot of continental slope, or by hundreds of meters (written 1, 2, 3, etc.) for ocean areas, except that travel time in half-seconds can be used if necessary. Color of isopach lines to indicate age range of covering rocks (black if unknown).

BOUNDARIES

Map-unit boundary: black line as on Geologic Map.

Boundary between continental and oceanic crust: generally shown by limit of distribution of oceanic crustal rocks, and in special cases by a map-unit boundary line. ------

Inner edge of continent affected by rifting and breakup (shown where data available): — - — - —

ROCKS OF ACTIVE PLATE MARGINS

Igneous rocks and undifferentiated sediments in present active plate margins in modern arc regions: overprints for igneous lithologies as on geologic map, and for sediments pattern of short horizontal dashes, closely spaced; patterns in color indicating age range of rocks, on white background.

CONTINENTAL CRUST

1. BASEMENT ROCKS

Metamorphic rocks, including complexes with metamorphosed igneous rocks (eg., gneisses, charnockites, metabasalts, etc): as on Geologic Map, with solid color showing age of major metamorphism.

Intrusive igneous rocks: as on Geologic Map, with solid color showing age of intrusion, except distinguish ultramafic intrusives (black) and ophiolites (purple) where possible. Indicate geologic age of ophiolite with appropriate letter symbols.

Deformed sedimentary and volcanic rocks (those generally deemed to be too deformed to contain hydrocarbons): to be shown by color to indicate age of major deformation, with black overprints for volcanic lithologies as on Geologic Map. Accretionary prisms or melange belts can be distinguished by an added line pattern showing trends of strata.

2. ROCKS OF TRANSITIONAL AND REACTIVATION BASINS

Transitional sequences*: deposits immediately succeed major deformation and immediately precede platform-strata deposition. Show by black map-unit boundary line (broken where concealed), with inner band of dots and dashes colored to indicate age range of rocks. Where deformed, fill area of unit with horizontal hatching (broken into long dashes where concealed) colored to indicate.

Igneous rocks include mostly felsic volcanics, bimodal volcanics, and post-kinematic granites and associated volcanics. Sedimentary rocks include molasse-like deposits, commonly in foredeeps and grabens.

Reactivation sequences: deposits are unrelated to preceding tectonism, except for inherited structural control. Rocks include some foredeep, graben and molasse-like deposits, and volcanics. Show by black map-unit boundary line with inner geometric dot-pattern banding in color indicating age range of rocks.

3. COVERING ROCKS

Continental-platform strata, including many "sedimentary basins", and also blanket deposits not in tectonic downwarps: the stratigraphic boundaries (unconformities; limits of preservation) of major tectonic or lithologic significance to be shown in black, with parallel bands in color to indicate age range of unit. Within boundaries, pastel tints present age of basement where known.

---

* As this unit is unfamiliar to many, it is described in more than usual detail. See also reprints previously supplied.

Continental margin deposits:

*Rift sequence: presence indicated by showing the thick deposits that accumulate in the rift valleys of shelves preceding continental breakup and sea-floor spreading; shown by an open circle pattern, color indicating age range of deposits.

*Drift sequence: deposits that accumulate over rift sequences and the rest of the contemporaneous shelf area after breakup; shown by a heavy dot pattern, color indicating age range of deposits.

Concealed rifts shown by dotted line colored to indicate age of inception.

Intraplate igneous rocks (plateau basalts and other anorogenic intrusives and extrusives): indicate kind of rock by pattern used on Geologic Map, but colored to show age; show basement in the same way as for continental-platform strata.

TECTONIC ELEMENTS

The active crustal plates have been identified on the Plate-Tectonic Map. Each plate can be divided into tectonic regions, such as fold belts and shields, on the basis of gross differences in structure and physiography. Such regions can be named on the Tectonic Map where their configurations are recognizable by the distribution of rock units, or possibly on an inset map. The names of tectonic sub-regions can be introduced in some places, if desirable.

CRUSTAL THICKNESS (for possible inclusion as a small-scale inset map)

Mohorovicic depth map: depth-contour interval 5 km above 10 km and 1 km below 10 km; if shown, propose a single compiler of worldwide data.

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* Rift and drift sequences are characteristic of the "passive margin" tectonic setting of continental shelves.

Table 10. Letter and number symbols for the Southwest Quadrant Tectonic Map indicating structural name, age span, and tectonic setting. Scheme developed by Erwin Scheibner and presented to the Interim Meeting of the Map Committee on August 22, 1982.

Letter Symbol	Structural Name & Age Span	Tectonic Setting (interpretation) & Brief Description
A	ARCHAEAN (3500-2500 Ma) (ARCHAEAN BLOCKS FROM THE AUSTRALIAN CRATONIC NUCLEII)	
A^1	Pilbara Block >3500-2500 Ma	Granitoid-greenstone terrain (Archaean orogenic setting).
A^2	Yilgarn Block >3100-2500 Ma	Proto-continental high-grade gneiss terrain (in the west; >3000 Ma) and granitoid-greenstone terrain (in the east, about 2700 Ma old).
AP	ARCHAEAN-PROTEROZOIC (PARTS OF THE OLD AUSTRALIAN CRATON)	
AP^1	Rum Jungle Block (Complex) >2500 Ma	Granitoid and gneiss dome terrain (>2500 Ma) younger metasediments, metadolerite and B.I.F.
AP^2	Litchfield Complex 2500-1800 Ma	Granitoid and gneiss terrane (about 2500-2400 Ma) deformed and metamorphosed 1800 Ma.
AP^3	Nanambu Complex >2500-1800 Ma	Granitoid and gneiss dome terrain (2500-2400 Ma), gneisses mantled by leucogneisses and schists.
P_1	EARLY PROTEROZOIC (2500-1700 Ma) (PARTS OF THE OLD AUSTRALIAN CRATON AND OLDEST PLATFORM ROCKS)	
P_1^1	Hamersley Basin 2700-2100 Ma	Cratonic cover - platform basin over Pilbara Block. Cratonic flood basalts overlain by sediments, including B.I.F.
P_1^2	Capricorn Orogen (Ashburton Trough, Gascoyne Prov., Glengarry Sub-basin) 2000-1900 Ma	Orogenic domain, sediments and volcanics metamorphosed and deformed 1900 Ma. Granitoids 1900-1600 Ma.
P_1^3	Halls Creek Inlier (Province) >2800-1960	Orogenic domain (Mobile zone) sedimentation & igneous activity 2800 to 2200 Ma, deformation & metamorphism 1960 Ma.

Letter Symbol	Structural Name & Age Span	Tectonic Setting (interpretation) & Brief Description
E_1^4	post-Halls Creek Province Rocks 1900-1750 Ma	Late orogenic domain (transitional). Felsic volcanics, granites & sediments about 1900 Ma old; final deformation before 1750 Ma.
E_1^5	Kimberley Basin 1815-1760 Ma	Cratonic cover - platform basin over Halls Creek Inlier (Province) rocks. Marine sediments & cratonic extrusives & intrusives; dolerite sills about 1760 Ma old.
E_1^6	Pine Creek Inlier (Palmerston Province) 2400-1690 Ma	Orogenic domain sedimentation & igneous activity 2400-1940 Ma. Metamorphism about 1870-1800 Ma. Granites 1890 & 1760 Ma. Dolerite lopolith 1690 Ma.
E_1^7	Arnhem Inlier (Block) >1950-1800 Ma	Orogenic domain, metamorphism 1945 Ma.
E_1^8	Murphy Inlier	Orogenic domain, metamorphism 1860 Ma, late orogenic granite & volcanics 1770 Ma.
E_1^9	Kalkadoom-Leichhardt Block 1860-1780 Ma	Late orogenic domain (transitional). Felsic volcanics & granites 1860 Ma; sediments, felsic & mafic volcanics 1800-1760 Ma; granite & metamorphism 1740-1700 Ma.
E_1^{10}	The Granites-Tanami Inlier (Block) >1960-1680 Ma	Orogenic domain (? mobile belt), metamorphism of sediments & volcanics 1810 Ma, overlain by sandstone & volcanics of late orogenic character. Granites 1770-1680 Ma.
E_1^{11}	Tennant Creek Inlier (Block) >1920-1660 Ma	Orogenic domain, marine sediments, felsic & mafic volcanics metamorphosed 1920 & 1810 Ma. Late orogenic domain represented by rocks 1790-1660 Ma.
E_1^{12}	Arunta Block >1810-1770 Ma	Orogenic domain (mobile belt), some older orogenic rocks correlated with Halls Creek Inlier, followed by sediments & volcanics 1800 Ma. Metamorphism & granite 1810-1770 Ma.

Letter Symbol	Structural Name & Age Span	Tectonic Setting (interpretation) & Brief Description
P_1^{13}	Gawler Craton (Block) 2600-2300 Ma >2000-1650 Ma	Orogenic domain; older complex of sediments, including B.I.F., basic volcanics 2600 Ma. Metamorphism and granite 2490-2300 Ma. Sediments, incl. B.I.F. metamorphosed 1815 and 1700 Ma. Granites 1650 Ma.
P_1^{14}	Willyama Inlier >1820-1700 Ma	Orogenic domain, sediments, including B.I.F. volcanics 1820 Ma. Metamorphism about 1700 Ma. Not shown late orogenic granite 1665-1520 Ma.
P_2	MIDDLE PROTEROZOIC (1700-1000 Ma) (PARTS OF THE OLD AUSTRALIAN CRATON AND ITS COVER)	
P_2^1	Nabberu Basin (Earaheedy Sub-basin) >1700-1550 Ma	Cratonic cover - over Capricorn Orogen & Yilgarn Block. Marine sediments include B.I.F. and basic volcanics.
P_2^2	Paterson Province 1400-1300 Ma	Orogenic domain was probably connected with the Musgrave Block.
P_2^3	McArthur Basin 1700->1280 Ma	Cratonic cover - platform basin, marine & continental sediments, basic & felsic volcanics, dolerite 1280 Ma.
P_2^4	South Nicholson Basin 1480-1300 Ma	Cratonic cover, marine & continental sediments, about 1480 Ma.
P_2^5	Mt. Isa Block 1700-1500 Ma	Orogenic domain, granites & felsic volcanics about 1680 Ma. Marine & continental sediments 1680-1600 Ma. Metamorphism 160-1500 Ma.
P_2^6	Arunta Block 1700-1400 Ma 1185- 900 Ma	Orogenic domain, high grade metamorphism & granites 1700-1550 & 1500-1420 Ma. Granites about 1700 & 1500 Ma. Mafic intrusives 1185 Ma. Metamorphism 1050 Ma. Late orogenic granite 1000 Ma. Mafic volcanics about 900 Ma.
P_2^7	Musgrave Block 1560-900 Ma	Orogenic domain, sediments 1560 Ma, felsic and intermediate volcanics & plutonics 1330 Ma, high grade metamorphism & granites 1200-1100 Ma. Late orogenic felsic volcanics, granites, basic-ultrabasic dykes 1050-900 Ma.

Letter Symbol	Structural Name & Age Span	Tectonic Setting (interpretation) & Brief Description
E_2^8	Albany-Frazer Province 1700-1250 Ma about 1076 Ma	Metamorphic belt (mobile belt) formed due to metamorphism & granite emplacement events about 1690-1560 & 1300-1250 Ma. Late orogenic granite 1076 Ma.
E_2^9	Gawler Block	Late orogenic domain, granite 1650 Ma, felsic volcanics & granite 1520-1420 Ma.
E_2^{10}	Wonaminta Inlier (Block)	Orogenic domain, metasediments & metatabasalts, possibly Mid Proterozoic.
E_2^{11}	Georgetown, Yabo and Coen Inliers (Blocks) 1600-1400 Ma (970 Ma)	Orogenic domain, marine sediments & mafic volcanics, metamorphism & granites 1570 Ma. More sediments metamorphosed & granites 1470 Ma. Felsic volcanics & granites 1400-1300 Ma. (Local metamorphism 970 Ma.)
E_2^{12}	Birrindudu Basin	Cratonic cover on the Granites-Tanami Inlier (Block), marine sediments over 1560 Ma old.
E_2^{13}	Victoria River Basin 1125-900 Ma	Cratonic cover in part over Birrundudu Basin & within Halls Creek Inlier. Marine & continental sediments.
E_2^{14}	Bangemall Basin 1075-1030 Ma	Cratonic cover over Nabberu Basin & Capricorn Orogen. Marine sediments & basic volcanics.
E_2^{15}	Northampton Black 1040 Ma	Orogenic domain, granulites about 1040 Ma intruded by granite with migmatites. All cut by dolerite dykes.
E_3	LATE PROTEROZOIC 1000-570 Ma)	
E_3^1	Naturaliste Block and Leewin Block 900-640 Ma	Orogenic domain, granulite-grade metamorphism about 650 Ma.
E_3^2	Rocky Cape and Tyenna Blocks 820-700 Ma	Orogenic domains, (inliers in Paleozoic orogenic belts) metasediments intruded by granites 817 & 735 Ma. Mafic volcanics 700 Ma, younger sediments.

Letter Symbol	Structural Name & Age Span	Tectonic Setting (interpretation) & Brief Description
$Є_3^3$	Adelaide Fold Belt, Amadeus, Ngalia, Officer and Georgina Basins 900-570 Ma	Cratonic cover, platform basins, some perhaps aulacogenes. Marine & continental sediments including tillites. Basic volcanics often during rifting & basin formation.
$Є_3^4$	Charleston Metamorphic Group (N.Z.) 700 Ma	Orogenic domain, (inlier in the Tuhua Orogen). Constant Gneiss 700 Ma.
Pz_1	EARLY PALEOZOIC UNIT	
Pz_1^1	Kanmantoo Fold Belt >570-450 Ma	Orogenic domain, (active plate margin) possible back-arc Kanmantoo Trough, volcanic arc (mafic to intermediate volc.), fore-arc area, deformed & metamorphosed & granite during Delamerian Orogeny (late Mid Cambrian to Ordovician); includes late orogenic domain continental to marine sediments Late Cambrian to Ordovician.
Pz_1^2	Lachlan Fold Belt (early part, Tasmania) >570-390 Ma	Orogenic domain, (active plate margin) back-arc Dundas Trough (ophiolites) & Nt, Read Volcanic Arc in Tasmania, deformed & metamorph. Late Cambrian followed by late orogenic Late Cambrian to Early Devonian sediments.
Pz_1^3	Lachlan Fold Belt (early part, N.S.W.) 570-430 Ma	Orogenic domain, (active plate margin) back-arc Wagga Marginal Sea, Molong Volcanic Arc, Monaro Slope & Basin fore-arc, deformed & metamorph. & granite Late Ordovician to Early Silurian (Benambran Orogeny) (possible allochthonous terrane).
Pz_1^4	Thomson Fold Belt (early part, Qld) >570-436 Ma	Orogenic domain, (active plate margin) possible back-arc basin and volcanic arc deformed and metamorph. Mid & Late Ordovician.
Pz_1^5	Tuhua Orogen	Orogenic domain, (active plate margin) back-arc basin, volcanic arc deformed metamorph., granite during Early Devonian Tuhua Orogeny.

Letter Symbol	Structural Name & Age Span	Tectonic Setting (interpretation) & Brief Description
Pz_1^6	Canning, Bonaparte Gulf, Arafura, Daly River, Wiso, Georgina, Amadeus (Ngalia) Officer & Arrowie Basins >570-300 Ma	Cratonic cover - platform basins (epicratonic) cratonic mafic volcanism common during initiation, marine & continental sediments.
Pz_1^7	Papuan Platform 360-247 Ma	Orogenic domain, basement of metamorphics, minor felsic volcanics, Carboniferous-Permian granites & diorites.
Pzm	MIDDLE PALEOZOIC UNIT	
Pzm^1	Lachlan Fold Belt (late part) 430-330- Ma	Orogenic domain, (active plate margin) wide back-arc region with some ensimatic (ophiolites) flysch troughs widespread felsic volcanics & granites bimodal volcanics in volcanic rifts. The volcanic arc & fore-arc & accretionary prizm (ophiolites) incorporated into younger New England Fold Belt. Includes late orogenic transitional domain Lambian province; bimodal volcanics during initial rifting, marine & continental deposits granites (A- & I-type). Terminal Kanimblan Orogeny (Mid Carboniferous), post-kinematic granite (I-type).
Pzm^2	Thomson Fold Belt (late part) 436-330 Ma	Orogenic domain,(active plate margin) back-arc region with widespread volcanism & granite. Includes late orogenic transitional domain Late Devonian to Early Carboniferous marine & continental sediments & volcanics & granites, Mid Carboniferous terminal orogeny, post-kinematic granites.
Pzm^3	Adavale, Drummond & Darling Basins 400-330 Ma	Late orogenic domain, marine & continental sedimentation, felsic volcanism, Mid Carboniferous terminal deformation.

Letter Symbol	Structural Name & Age Span	Tectonic Setting (interpretation) & Brief Description
Pzm4	Hodgkinson-Broken River Fold Belt 450-330 Ma (330-235 Ma)	Orogenic domain,(active plate margin) volcaniclastic flysch & carbonates of shelf facies, granites, deformed & metamorphosed in Devonian, includes late orogenic domain felsic volcanics and granite, terminal deformation Mid Carboniferous, post-kinematic granite (330-235 Ma).
Pzm5	Canning Basin (Fitzroy Trough) & Bonaparte Gulf Basin 410-300 Ma	Cratonic cover, platform basin, could be a Sloss-Vail unit associated with plate margin reorganization.
Pzm6	Georgina, Ngalia, Amadeus & Officer Basins 410-300 Ma	Cratonic cover - molasse-like deposits.
PP	PRE-PERMIAN UNIT	
PP	Metamorphic massif (New Caledonia) 300 Ma	Orogenic domain, polymetamorphosed volcano-sedimentary complexes.
Pz_2	LATE PALEOZOIC UNIT	
Pz_2^1	Canning & Officer Basins 300-240 Ma	Cratonic cover, platform basin, glacial & other sediments.
Pz_2^2	New England Fold Belt (New England & Yarrol Province) 550-220 Ma	Orogenic domain (active plate margin), volcanic arc--fore-arc area - accretionary prizm (ophiolites), deformation & granite Late Carboniferous, localized high pressure metamorphism. Late Carboniferous to Early Permian magmatic arc & accretionary prizm deformed & metamorphosed in Mid Permian. Post-kinematic felsic volcanics & granite.
Pz_2^3	Sydney-Bowen Basin 320-195 Ma	Cratonic cover on the west & late orogenic domain (fore-deep) on the east, where the New England F. B. thrust over the foredeep. Bimodal volcanism, marine & continental sediments.

Letter Symbol	Structural Name & Age Span	Tectonic Setting (interpretation) & Brief Description
Pz_2^4	Tasmania Basin	Cratonic cover, (include small cover areas in the Lachlan F. B.) continental & marine sediments.
Pz_2^5	Parapara Peak area (N.Z.) 290-235 Ma	Cratonic cover, (non-volcanic) shelf sequence over western foreland.
Pz_2^6	Kubor Anticline (New Guinea Mobile Belt) 300-247 Ma	Orogenic to late orogenic domain, originally part of Tasman Fold Belt System, granites, granodiorites intruding metamorphics.
PR	PERMO-TRIASSIC UNIT	
PR^1	Canning & Bonaparte Gulf Basins 300-185 Ma	Infra-rift sequences (continental margin).
PR^2	Perth & Carnarvon Basins 300-200 Ma	Infra-rift sequence (continental margin).
PR^3	Galilee Basin 300-195 Ma	Cratonic cover to late orogenic basin
PR^4	Pedirka, Arckaringa & Cooper Basins 300-195 Ma	Cratonic cover, platform basins
PR^5	Permo-Triassic East Coast & Central Chain N. Caledonia 270-205 Ma	Orogenic or late orogenic domain, ? bimodal volcanics, felsic volcanics, marine & continental sediments.
Ћ	TRIASSIC UNIT	
$Ћ^1$	Esk Rift, Gympie Basin & Abercorn Trough 235-212 Ma	Late orogenic domain, continental & marine sediments, felsic & intermediate to mafic volcanics.
$Ћ^2$	Ipswich Basin 220-195 Ma	? Late orogenic domain, felsic volcanics & continental clastics with coal in the Ipswich and similar basins.

Letter Symbol	Structural Name & Age Span	Tectonic Setting (interpretation) & Brief Description
TR ^{3}	Papuan Platform & Kubor Anticline	Cratonic cover, sediments & intermediate to felsic volcanics.
Pz_2-J	LATE PALEOZOIC - JURASSIC UNIT	
Pz_2-J^1	Rangitata Orogen 300-135 Ma	Orogenic domain, (active plate margin), deformation & metamorphism, Late Jurassic to Early Cretaceous. In the west: Volcanic arc, mid-slope basin, frontal arc wedge; Dun Mountain ophiolites trench slope break; Pelorus Zone accretionary wedge; Haast Schist Zone accretionary wedge; Torlesse Zone accretionary wedge of continental margin setting.
TR -J	TRIASSIC - JURASSIC UNIT	
TR -J^1	Rangitata Orogen (Chatham Rise & eastern N. Island, NZ)	Orogenic domain, greywacke sequence.
TR -J^2	New Caledonia 200-1600 Ma	? Cratonic cover, volcano-sedimentary facies, includes Late Jurassic volcano-sedimentary facies.
J	JURASSIC UNIT	
J^1	Tasmania dolerite & other cratonic ign. rocks in E. Australia	Cratonic (intraplate) igneous activity associated probably with Gondwana breakup.
J^2	NW Australian shelf rift-grabens	Continental margin rifting.
J^3	East Indian Ocean crust M27-M17 Mag. anomaly	Oceanic crustal domain.
J^4	West Pacific Ocean crust >M17 Mag. anomaly	Oceanic crustal domain.

Letter Symbol	Structural Name & Age Span	Tectonic Setting (interpretation) & Brief Description
J-K	JURASSIC - CRETACEOUS UNIT	
J-K1	Carpentaria, Eromanga, Surat, Clarence-Moreton, Nambour & Maryborough 200-80 Ma	Cratonic cover, epicontinental down-warps start locally in latest Triassic, continental & marine sediments, some intermediate volcs. in Maryborough B.
J-K2	Granites	? Anorogenic or post-orogenic granites NE Queensland & NE N.S.W.
J-K3	Papuan Platform & Papuan Fold Belt 195-65 Ma	Cratonic cover, continental to marginal marine deposited on Australian continental & its faulted margin.
J-K4	Australian shelf rift-grabens	Continental margin rifting.
J-K5	East Indian Ocean crust M17-34 Mag. anomaly	Oceanic crustal domain.
J-K6	West Pacific Oceanic crust M17-34 Mag. anomaly	Oceanic crustal domain.
K	CRETACEOUS UNIT	
K1	Canning & Officer Basins & Northern Australia 135-110 Ma	Cratonic cover, thin sequence of epicratonic clastics.
K2	Perth & Carnarvon Basins 135-70 Ma	Continental margin basins, drift associated, continental & marine sediments.
K3	Gippsland, Bass, Ottway & Great Australian Bight	Continental margin rift-grabens, marginal marine to continental sediments.
K4	Styx Basin	Continental margin basin, sediments & igneous rocks.
Mz	MESOZOIC UNIT	
Mz	Canning Basin	Cratonic cover, continental deposits of uncertain affinities & age on the eastern margin of the Canning Basin.

Letter Symbol	Structural Name & Age Span	Tectonic Setting (interpretation) & Brief Description
J-To or J-Te	JURASSIC TO EOCENE OR OLIGOCENE UNIT	
J-Te[1]	New Guinea Mobile Belt 195-40 Ma	Orogenic domain, active plate margin setting, leading to continent/island arc collision; emplacement (obduction) Papuan Ultramafic Belt & other ophiolites, high pressure metamorphism, Mid Tertiary orogeny.
J-To[2]	Allochthonous assemblage of Northland N.Z. 195-25 Ma	Orogenic domain, active plate margin setting. Mesozoic seafloor volcanics & Cretaceous to Oligocene exotic sediments ? obducted.
K-To	CRETACEOUS TO OLIGOCENE UNIT	
K-To	NE of N. Island, NZ 120-25 Ma	Continental margin setting, drift sequence of Campbell Plateau - Chatham Rise assoc. with separation from W. Antarctica.
Ku-Te & Ku-To	LATE CRETACEOUS TO EOCENE OR OLIGOCENE UNIT	
Ku-Te[1]	Aure Trough 86-40 Ma	Orogenic domain, continental margin trough with spilitic volcanism & pelagic sediments. Oligocene deformation.
KuTe[2]	New Caledonia 140-55 Ma	Orogenic domain, active plate margin in setting; volcanic rift (? arc) & sediments followed by obduction of ophiolite naps during Eocene, high pressure metamorphism.
KuTe[3]	Solomon Islands	Orogenic domain, active plate margin, oceanic crustal basement & sediments, region, metamorphism (44 Ma).
Ju-Q	LATE JURASSIC TO QUATERNARY UNIT	
Ju-Q	NW Australian Shelf	Continental margin setting, drift sequence since early phase opening of of Indian Ocean.

Letter Symbol	Structural Name & Age Span	Tectonic Setting (interpretation) & Brief Description
Kl-Q	EARLY CRETACEOUS TO QUATERNARY UNIT	
Kl-Q	Australian shelf	Continental margin setting, drift sequence.
Ku-Q	LATE CRETACEOUS TO QUATERNARY UNIT	
Ku-Q[1]	Australian shelf 76-0 Ma	Continental margin setting, drift sequence since opening of the Tasman Sea.
Ku-Q[2]	Cratonic volcanics Campbell Plateau- Chatham Rise 90-0 Ma	Cratonic igneous activity (intraplate) associated with breakup from W. Antarctica; incl. East Cape Matakaoa basalts (K-Tm?).
Ku-Tpal	LATE CRETACEOUS-PALEOCENE UNIT	
	Tasman & Coral Sea Crust 76-55 Ma	Oceanic crustal domain.
Ku-Tm	LATE CRETACEOUS TO MIOCENE UNIT	
Ku-Tm	Papuan Platform & Central Orogenic Belt P.N.G. 90-5 Ma	Cratonic cover, reefal & platform carbonates, some involved in deformation in Papuan Fold Belt.
Tpal-To	PALEOCENE TO OLIGOCENE UNIT	
Tpal-To	Island arc volcanics P.N.G. & other 65-25 Ma	Orogenic domain, active plate margin, ? arc volcanism.
Tpal-Q	PALEOCENE TO QUATERNARY UNIT	
Tpal-Q	NE Australian shelf	Continental margin setting, drift sequence since opening of the Coral Sea.
Cz	CAINOZOIC UNIT	
Cz[1]	Cainozoic downwarps Australia 65-0 Ma	Cratonic cover, epicratonic downwarps in the continental interior.

Letter Symbol	Structural Name & Age Span	Tectonic Setting (interpretation) & Brief Description
Cz[2]	Cratonic igneous rocks Australia 65-0 Ma	Cratonic - intraplate volcanics & intrusives; plateau basalts, shield volcanoes, etc.
Cz[3]	Tasman Sea sea mounts	Intraplate volcanics, oceanic island volcanism (basalts).
Te	EOCENE UNIT	
Te[1]	New Caledonia (east coast) 55-25 Ma	Orogenic domain or ? late orogenic, olistostromes, sediments & granites (25 Ma).
Te[2]	Arc volcanics Fiji (Viti Levu, Yasawas & Beqa) 45-37 Ma	Orogenic domain, active plate margin volcanic arc volcanics mafic to felsic intruded by tonalite of the first orogenic phase.
Te-Tm (Te-To)	EOCENE TO MIOCENE UNIT	
Te-To[1]	Epicratonic basins N.Z. 55-25 Ma	Cratonic cover,epicratonic sequences, coal measures to carbonate platform deposits.
Te-Q	EOCENE TO QUATERNARY UNIT	
Te-Q	Southern Ocean Crust 55-0 Ma	Oceanic crustal domain.
To-Tm	OLIGOCENE TO MIOCENE UNIT	
To-Tm[1]	Aure Trough (P.N.G.) 40-5 Ma	Late Orogenic setting foreland (deep) basin, sediments derived from the rising New Guinea Mobile Belt.
To-Tm[2]	Papuan Platform & Papuan Fold Belt 40-15 Ma	Cratonic cover,marine sediments partly involved in deformation of Papuan Fold Belt.
To-Tm[3]	Island arcs adjacent to P.N.G. 40-5 Ma	Orogenic domain, active plate margin, island arcs & marginal seas, sediments & volcanics.
To-Tm[4]	Island arc, Fiji (Viti Levu, Yasawas, & Bega) 24-10 Ma	Orogenic domain, active plate margin, volcanic arc volcanics & sediments, lack of plutonics.

Letter Symbol	Structural Name & Age Span	Tectonic Setting (interpretation) & Brief Description
To-Tm5	Vanuatu 25-11 Ma	Orogenic domain, island arc volcanics & sediments; Early Miocene faulting.
To-Tm6	Solomon Islands 25-7 Ma	Orogenic domain, active plate margin, volcanic arc volcanics, Late Oligocene diorites on Guadalcanal, Miocene sediments.
Tm	MIOCENE UNIT	
Tm1	New Caledonia (west coast) 22-10 Ma	? Late orogenic setting, sediments.
Tm2	Island arcs adjacent to P.N.G. 22-5 Ma	Orogenic domain, active plate margin, post-P.N.G. collision sediments & volcaniclastics.
Tm3	Island arc Fiji (Yasawas) 10-7 Ma	Orogenic domain, active plate margin, tholeiitic island arc mafic to felsic, volcaniclastics from Oligocene uplift; gabbro & tonalite assoc. 2nd orogenic phase.
Tm-Tp	MIOCENE - PLIOCENE UNIT	
Tm-Tp1	Papuan Platform (P.N.G.) 25-3 Ma	Cratonic cover,thin terrigenous clastics.
Tm-Tp2	Aure Trough 25-3 Ma	Late orogenic setting; thick sequence of marine deposits.
Tm-Tp3	Maramuni Volcanic Arc (P.N.G.) 25-2.5 Ma	? Orogenic domain.
Tm-Tp4	Volcanic Arc Fiji (Viti Levu, Yasawas, Beqa, Vanua Levu, Lomaiviti) 6-2 Ma	Orogenic domain, active plate margin; calc-alkaline to tholeiitic arc volcanics, sediments, on Lomaiviti also shoshonites.
Tm-Tp5	Taranaki Graben & Solander Trough (N.Z.) 25-2 Ma	Orogenic domain, active plate margin, volcanic rift & interarc basin, volcanic arc.

Letter Symbol	Structural Name & Age Span	Tectonic Setting (interpretation) & Brief Description
Tm-Tp[6]	Vanuatu 8-1.8 Ma	Orogenic domain, active plate margin, sediments above older volcanic arc.
Tm-Q	MIOCENE TO QUATERNARY UNIT	
Tm-Q[1]	Island arcs adjacent to P.N.G.	Orogenic domain, active plate margin sediments, thick volcaniclastics in back-arc/fore arc basins, pelagic sediments in marginal basins, intermediate intrusives.
Tm-Q[2]	New Zealand shelf deposits 25-0 Ma	Cratonic cover, prograding continental shelf deposits.
Tm-Q[3]	Cratonic volcanics N. Island N.Z.	? Cratonic volcanics, mafic to intermediate volcanics assoc. western rifts & Northland "volcanic arc".
Tm-Q[4]	Epicratonic basin North Island N.Z.	Cratonic cover, epicratonic basin sequence in west-central & northern North Island, N.Z.
Tm-Q[5]	Taupo Rift (N.Z.)	Orogenic domain, volcanic rift-volcanic arc in active plate margin. ?
Tm-Q[6]	East Coast N. Island N. Z.	Late orogenic setting, continental shelf deposits derived from contemporaneous uplift.
Tp	PLIOCENE UNIT	
Tp[1]	Central Orogenic Belt (P.N.G.) 5-1.8 Ma	Late orogenic setting, molasse-like accumulations, some involved in deformation Papuan Fold Belt.
Tp[2]	Shoshonitic volcanics Fiji 5-1.8 Ma	Orogenic domain?, ? rifting in late orogenic setting? ?intraplate volcanism.
Tp[3]	Wairarapa-Hawkes Bay basin, N.Z. 5-1.8 Ma	Orogenic to late orogenic setting active continental margin sediments.
Tp-Q	PLIOCENE TO QUATERNARY UNIT	
Tp-Q[1]	Volcanics & intrusives P.N.G. 5-0 Ma.	Orogenic domain?

Letter Symbol	Structural Name & Age Span	Tectonic Setting (interpretation) & Brief Description
Tp-Q[2]	Papuan Platform 3-0 Ma	Cratonic cover, sediments.
Tp-Q[3]	Papuan Fold Belt 5-1 Ma	Orogenic to late orogenic setting fore-land zone of thrusting, diapirism.
Tp-Q[4]	Aure Trough 5-1 Ma	Late orogenic setting, thick clastics mud volcanoes.
Tp-Q[5]	New Caledonia 5-1 Ma	Cratonic cover, to ? late orogenic environment.
Tp-Q[6]	Shoshonitic volcanics & alkali basalts, Fiji 5-0 Ma	Orogenic domain?, ? rifting in late orogenic setting? ? intraplate volcanism.
Tp-Q[7]	Cratonic volcanics Northland & Auckland 5-0 Ma	Cratonic-intraplate volcanics post-tectonic alkaline volcanics.
Tp-Q[8]	Wanganui Basin, Hauraki Gulf-Thames Graben 5-0 Ma	? Late orogenic setting, downwarp and rift.
Tp-Q[9]	Active margin sequence 5-0 Ma	? Late orogenic setting, fill of ? foredeep assoc. with active plate margin.

Table 11. Report of an ad hoc panel on gravity data for the Geodynamics Map Series.

Memorandum

To: The Record

From: Maurice J. Terman, Deputy Chairman for Scientific Coordination

Subject: Recommendations of ad hoc expert panel on presentation of gravity data on Circum-Pacific Map Project bases

The following expert consultants met as an invited panel in the Chief Geologist's Conference Room at the USGS National Center, on February 23, 1982, to discuss alternative methods of presentation for gravity data on the Circum-Pacific Map Project bases:

John M. DeNoyer of USGS
Bruce D. Marsh of Johns Hopkins University
James G. Marsh of NASA
Richard H. Rapp of Ohio State University
David Sandwell of NOAA
Philip M. Schwimmer of DMA
William E. Strange of NOAA
Anthony B. Watts of Lamont-Doherty Geological Observatory
Isidore Zeitz of USGS

Terman outlined the background philosophy and compilation progress of the Map Project. Strange reviewed continental data sets, particularly the new digital 5-minute, Bouguer values from ground observations for the United States. Watts discussed the analytical advantages of the 2 1/4 million free-air data points from ship-board observations in the Pacific. And finally, Rapp emphasized the importance of the completely uniform coverage of 1° mean block free-air values from satellite observations over oceans between 72° north and south latitude. All attendees participated in a very fine exchange of views on their contrasting data sets. After some six hours of discussion, the following recommendations were made for the Circum-Pacific Map Project Gravity Map:

1) Show free-air gravity data over water and land, but leave blank where data not available; use 25 mg contour interval except where data and gradients will not permit, and particularly show good color distinctions between ± 100 mg; much of the peripheral Western Pacific area can be mapped by digitizing and replotting the Watts surface-ship gravity maps published by GSA.

2) Have Rapp forward to Watts a satellite-data tape for the same area as the existing Hawaiian map by Watts; Tony will plot and review the compatibility of the two sets and notify Terman by May 1, 1982, if he feels that the 1° mean block values can be merged with and used to extend his existing maps.

(a) If Watts answers yes, block values will be printed throughout the rest of the ocean areas (to 72° N and S) and automatically contoured; many units would be shown by pastel shades of similar hues to those for ship data, but different enough to clearly differentiate the two data sets.

(b) If Watts answers no, DMA will assist in plotting free-air values for all available ship tracks and Tony will reevaluate possibility of contouring where data is dense enough; some large areas, particularly in the South Pacific, might well be left blank except for isolated track lines, and it may be advisable to fill these areas with satellite-data derivatives, even if they cannot be merged with ship-board data.

3) On the back of the map, print geoid contours over ocean areas using a two-meter contour; Jim Marsh will provide a statement on best technique to Terman by May 1, 1982.

4) Do not show any other parametric values on the Gravity Map.

Table 12. Compilation guidelines for the Geodynamics Map Series.

Gravity: Free-air anomalies over water and land; interval of 25 mgal except where data and gradients will not permit. (On printed map: yellow tints between +50 and -50 mgal, red tints for positive values +50 mgal and blue tints for negative values below -50 mgal or comparable colored lines to denote anomalies.) Anomalies are from satellite data.

Seismicity:

Epicenters - in gray, from Plate-Tectonic Map sheets.

Focal mechanisms - selected first-motion studies shown by beachball symbols; colors indicate depth ranges; same as for epicenters on Plate-Tectonic Map sheets; beachballs centered over locations where possible. Compiled by Fred Mauk and Art Tarr, USGS.

State of lithospheric stress: Principal stress vectors.

Volcanoes (Holocene): In purple, from Plate-Tectonic Maps.

Faults: Active during Holocene (in red): displacement has occurred within the past 10,000 years.

Lineaments: Trends suggested by satellite sensors, particularly Landsat, in brown.

FOR INCLUSION AS SMALL-SCALE INSET MAPS

Crustal thickness: Mohorovicic discontinuity depth contour interval 5 km above 10 km and 1 km below 10 km (see Tectonics v. 1, no. 2, April 1982) (To be shown on an inset map).

Magnetic anomalies: From satellite data, contour interval 2 nanoteslas (see Geophysical Research Letters, v. 9, April 1982).

Geoid anomalies: From satellite data, contour interval 2 m.y. (see attached Marsh map).

Table 13. Compilation guidelines for the Energy Resources Map Series. (September 1982)

Background Map (patterns and colors to be determined)

Volcanic cover - may be shown where nature of underlying rock is unknown

Surficial deposits - as above

Basement rock - all shown by one pattern

Salt domes - areas to be shown by pattern (not individual domes)

Faults - selected

Anticlinal axes - selected

Sedimentary basins

Isopach lines - from the Tectonic Map Series

Basin tints - may be shown to indicate sediment thickness

Border line enclosing basin - if needed to define basin

Index map - to be compiled by each panel for explanatory booklet

Basin names - to be selected by each panel (Coury and Hendricks, 1978, and St. John, 1980 are suggested references). To be shown on map, if possible; otherwise in explanatory booklet.

Ocean areas

Bathymetry - screened blue, updated from the Geographic Map Series

Sediment isopachs - from the Tectonic Map Series

Resources

Oil and gas, oil sands, and oil shale

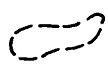
	Large or closely spaced small fields	Small field	Color
Oil (or oil and gas)		●	Green
Gas		●	Red

Giant fields - identified by name on map and on index map

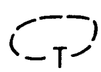
Generalized stratigraphic column - compiled for each basin with giant field and for selected other basins, as needed

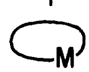
	Large or closely spaced small fields	Small field	Color
Oil sands			Green
Oil shale - minimum grade to be shown 40 liter/ton			Blue

Coal

	Large or closely spaced small fields	Small field	Color
Anthracite and semianthracite		▲	Brown
Bituminous		▼	Brown
Subbituminous		■	Brown
Lignite		●	Brown
Rank not identified		×	Brown

Age of coal (to be indicated--if known--by letter same as geologic-map symbol)

 Tertiary (lignite)

 Mesozoic (rank not identified)

Definition - each panel to describe criteria for what is mapped (e.g., "potentially recoverable")

Geothermal energy

Heatflow spot data - values in excess of 200 milliwatts/m^2 to be printed alongside symbol. Date provided by World Data Center A, Boulder, Colorado; revised and expanded data set to be available in 1983.

Milliwatts/m^2	Symbol	
< 25	△	black
25 - 50	△	purple
50 - 75	△	blue
75 - 100	△	green
100 - 150	△	brown
150 - 200	△	orange
> 200	△250	red

Geothermal convection system

Developed

> 150° C.

Vapor dominated - steam and vapor-dominated dry steam	◆	red
Hot water	●	red

90° - 150° C.

Vapor dominated	◆	blue
Hot water	●	blue
Potential	▒	gray

Resource data

Suggested format attached

Stratigraphic column

Form not defined

PETROLEUM AND COAL RESOURCES OF PRINCIPAL SEDIMENTARY BASINS

BASIN	PETROLEUM						COAL				
	Type	Reservoir			API°	Reserves 2/	Age	Rank	Ash 3/	Sulfur 4/	Reserves 5/
		Age	Type	Depth 1/							
Blue Fox	Oil	Cret.	Struct.	S			T,K,D	Lignite	Hi	Lo	
		Dev.	Strat.	M							
	Gas										
	Oil Sand										

1/ Depth of Reservoir: S-less than____ft., M-____ft. to____ft., D-greater than____ft.
2/ Petroleum Reserves: S-less than____Bbls., M-____Bbls. to____Bbls., L-more than____Bbls.
3/ Ash: Lo-less than____%, Hi-more than____%
4/ Sulfur: Lo-less than____%, Hi-more than____%
5/ Reserves of Coal: S-less than____tons, M-____tons to____tons, L-more than____tons

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