

Report of External Review Committee

on

**Proposed Department of Earth and
Planetary Science**

**Addressed to:
Dean, Graduate School of Science
The University of Tokyo**

April 16, 1999

Summary of Recommendations

1. The reorganization of the present four Departments (Earth and Planetary Physics, Geology, Geography, and Mineralogy) into a single Department of Earth and Planetary Science will remove disciplinary and administrative barriers that have built up over the past 100 years. It is strongly recommended that this reorganization be implemented as soon as possible.
2. The present situation of having the new Department distributed among the three buildings of the former departments will severely hamper teaching and collaborative research. It is strongly recommended that the new Department be consolidated in a single location by construction of a central building. This should be ranked as a top priority in the building plans of The University of Tokyo.
3. The decrease in the number of Research Associate positions (due partly to the recent reform of the Graduate School) is creating serious problems. A partial solution is to diminish the distinctions between Research Associates and post-doctoral fellows (at all major universities in Japan, not just in the new Department). The term of postdoctoral fellowships should be extended, and postdoctoral fellows should be allowed to participate in teaching. At least some Research Associateships should be made term appointments rather than tenured posts.
4. High quality technical support, in sufficient quantity, is absolutely essential to providing a productive, world-class scientific research effort. Mechanisms must be found to allow hiring of additional technicians from external grant funds, and additional funds should be provided for technicians who provide general support. Such technicians should in general be contract employees rather than permanent civil servants.
5. The quality of the core faculty members of the proposed new Department is generally high, and many of them reach a high international level. However, some of the faculty only reach a reasonable national level. Such faculty members should make efforts to improve their research activity. Publication of research results in English, especially in leading international journals, is particularly important.
6. The reorganization plan is well considered; however, the Review Committee perceives minor problems in the organization of the groups and subgroups. The new Department should periodically review and, if necessary, revise its internal structure as the research directions of the faculty members evolve. As earth and planetary science evolves, a broad range of new disciplines are becoming increasingly important. The new Department should continually be considering the possibility of expanding into such new areas.
7. The relation of the new Department with the Affiliated Institutions (the Earthquake Research Institute, Ocean Research Institute, The Institute of Space and Astronautical Science, etc.) should be strengthened in both teaching and cooperative research.
8. Efforts should be made to hire more foreign and female faculty members, in order to introduce fresh thinking and greater diversity.
9. Most faculty members are spending too much time on administrative duties. Efforts should be made to increase the time available to the faculty for research and teaching.

10. The educational program should be revised as follows.
 - (a) The undergraduate program should include required survey courses in geological sciences for earth and planetary physics majors, and required survey courses in earth and planetary physics for geological sciences majors. It is important to give all undergraduate students experience in basic experimental science.
 - (b) The following major changes should be made in the masters degree program: (i) All students should take broad-based survey courses in the first semester. (ii) The curriculum should be reviewed to maximize interdisciplinarity and to reduce the number of courses. (iii) Students should spend their first semester in residence at the Hongo campus, and should only thereafter pick their research topic. (iv) Students should have a multi-member advisory panel rather than a single advisor. (v) Systematic career-placement advising should be given to students who will not be continuing for a doctorate. (vi) Masters theses should be designed to emphasize development of a student's critical faculties.
 - (c) The doctoral program should be revised as follows: (i) Students should have an advisory committee that includes faculty from outside their immediate research group. (ii) At 18 months into the doctoral course, the advisory committee should assess the student's progress and knowledge of the research field by requiring submission of a short written report and conducting an oral examination. (iii) All doctoral theses should be written in English.
 - (d) Much greater emphasis should be placed on developing communication skills at all levels of the curriculum. (i) Students should be given training to improve their writing and speaking ability in both Japanese and English. (ii) Seminar courses should be used to improve presentation skills as well as scientific knowledge. Student presentations should be evaluated on the basis of peer-evaluation.
11. Faculty with expertise in geochemistry should be added to the new Department. Part of the Laboratory for Earthquake Chemistry of the Graduate School of Science should therefore be incorporated into the new Department.
12. After 3 years there should be a report on how these recommendations have been implemented, including a discussion of the organization of the research groups and the establishment of an Advisory Council to advise the new Department on general policy regarding teaching, research, and the relations of the new Department to society.

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1 Overview

The University of Tokyo is traditionally ranked as the premier university in Japan. It must respond to changing national and international requirements and continually re-justify its ranking in research and education.

The planned reorganization of the earth and planetary science departments will be a revolutionary event in the history of these disciplines at The University of Tokyo. This plan will remove barriers that have existed for more than 100 years between four Departments (currently named Earth and Planetary Physics, Geology, Mineralogy, and Geography). Recent progress in earth and planetary science requires interdisciplinary research and education on the basis of strong programs in the various disciplines in this field. The proposed reorganization is essential to meet this international trend. The proposed reorganization will lead to more flexible and effective graduate and undergraduate education as well as enhanced research across the breadth of earth and planetary science.

The Review Committee appreciates the effort of the faculty of the four departments in fostering the reorganization plan. We strongly support the reorganization plan and recommend that it be realized as soon as possible. Our report suggests how this process can be optimized.

This ambitious reorganization plan appears to involve some overlap in research areas and will probably evolve dynamically. The Review Committee therefore suggests that periodic reviews, and if needed, rearrangement of the faculty groups and subgroups should be conducted. The interdisciplinary character of research in earth and planetary science will require close collaboration among the core faculty in the Department and improved interaction with the Affiliated Institutions¹.

While the expertise of the new Department is broad, there are areas in which expertise is missing, and expansion into these areas may be required in the future. Examples include global geochemistry, the study of the cryosphere (snow- and ice-covered regions), and surface-water geochemistry.

This report focuses on the new Department, but it is also necessary to consider the role of the new Department in an overall national context. In order to improve the overall national level of research and teaching in earth and planetary science, it is desirable to create a system in which all leading institutions, including the new Department, compete for resources on the basis of objective external evaluation. It also is desirable, as discussed elsewhere in this report, to encourage mobility of faculty and students between universities. The Review Committee urges that steps be taken towards these goals. This will require action by the Ministry of Education, Science, Sports and Culture (Monbusho) and by researchers at other institutions, as well as by the new Department.

As the Review Committee was convened by the Dean of the Graduate School of Science, this report is addressed to the Dean. However, the Review Committee is aware that implementation of some of its recommendations, in particular items #1 through #4 in the Summary of Recommendations, are likely to require action by Monbusho and the central administration of The University of Tokyo, as well as by the Graduate School of Science. The Review Committee therefore requests the Dean to call these recommendations to the attention of Monbusho and the central administration, and to ask that action be taken to implement them.

¹This term denotes the Laboratory for Earthquake Chemistry of the Graduate School of Science, the Earthquake Research Institute, Ocean Research Institute, Center for Climate System Research, Institute of Solid State Physics, Center for Spatial Information Science, University Museum, Graduate School of Frontier Science, and Graduate School of Arts and Sciences of The University of Tokyo, and The Institute of Space and Astronautical Science. Some of the faculty members of each of these institutes (the "Affiliated Faculty") participate in graduate education in Earth and Planetary Science.

2 Teaching

The University of Tokyo provides education in earth and planetary science at the undergraduate, masters and doctoral level. In 1992-93 the overall emphasis of the teaching function of the four departments involved in this review shifted from undergraduate towards graduate education. Some of the emerging consequences of this major change require response to extract the maximum benefit.

2.1 Undergraduate program

Despite the changes, undergraduate teaching remains an important element. Two main programs of undergraduate teaching are planned in the new Department at the undergraduate level: Earth and Planetary Physics and Geological Sciences. The Review Committee felt that this separation was satisfactory, but that some element of mandatory cross-fertilization between the physics/chemistry/mathematically based program and the geologically based program was necessary. It is important to give all students experience in basic experimental science.

2.2 Masters program

The committee felt that major change should be undertaken at the masters level. The new Department (and faculty from affiliated institutions) must accommodate to the new educational boundary conditions.

The target number for admission of masters students is now twice that of the undergraduate target. In practice, wisely, the departments have held short of reaching that target. The immediate consequence of increased student numbers is that the faculty can no longer assume that the vast majority of students will be "home-grown." Furthermore, and also in contrast with the past, the number of available doctoral places in the new Department will be half of the targeted masters level places. Even allowing for possible movement between institutions, it is clear that a substantial number of students will end their education at the masters level. For this reason, the masters program must be developed and opened out. Near the beginning it must ensure smooth assimilation of students from diverse backgrounds and by its end it must be more than a "doctoral preparation" program.

The primary source of incoming masters students remains The University of Tokyo. Given its preeminent standards, this in itself is not bad. However, the influx of new students whose undergraduate career has been spent at other universities has broadened the range of ability and knowledge of the incoming masters students. There is a need for filling gaps in students' knowledge, and there should be judicious use of the third- and fourth-year undergraduate courses.

There is a concern that the education from undergraduate through masters to doctorate has become a process of ever narrowing specialization. There is a strong need to widen students' horizons. The Review Committee proposes that entry into the masters program is the correct point for attention to this question. It recommends that all students in the first months of the masters program take introductory broad-based courses that introduce the interdisciplinary conception of earth and planetary system science. This will not only provide a wider context for later studies but also leave potential openings for later changes of direction.

There was some concern over the number and relatively specialized nature of masters level courses. Given the information from the university catalog, the Review Committee was cautious in commenting on the nature and quality of the courses offered. The general comment was made that it seems that too many courses are offered, but nonetheless, certain Review Committee members felt there were also discernible gaps that must be filled if the program is to provide

the interdisciplinarity aimed for. It is proposed that an internal in-depth review of the overall curriculum should be undertaken with the aim of redefining the course content and ensuring that the curriculum matches as closely as possible the broad and laudable aims of the new interdisciplinary department. In the cause of opening out the syllabus, team teaching should be considered as a matter of course for the larger introductory courses. There should also be a firm rule that faculty should not continue to teach the same course for extended periods of time.

In the past, education to doctoral level has all too often followed almost an "indenturing" system whereby the student has a single supervisor chosen at the start of the masters program and remains with that professor through to doctorate. It is advised that students defer the choice of their research topic until at least the end of the first semester of the masters course. Moreover, students should proceed to a masters thesis with a broad-based thesis advisory panel to counterbalance the tendency to specialize too soon. This advisory panel might also counsel the student on career planning and on the choice of continuation, or not, to doctoral level.

The Review Committee proposes that a single faculty member be assigned or hired to oversee career advice and preparation for those students who will not go on to academic careers. Short courses on special themes should be introduced and moreover, as discussed below, emphasis must be placed on the assimilation and presentation of technical material through the use of dedicated student seminars. The view of what constitutes the content of a masters thesis itself might be adjusted; it need not be simply a "first-run" at a doctoral problem. Some members of the Review Committee felt that a thesis could concentrate more on broad review of a field or a topic, although others emphasized a need for some original elements. In any case, development of a student's critical faculties should be the major priority.

The affiliated faculty also need to adjust to the needs of the new masters environment. In view of the more varied backgrounds of the students and the consequent need for less narrow academic approaches, it is recommended that students spend at least the first semester of the masters course at the Hongo campus rather than immediately being based in one of the Affiliated Institutions.

2.3 Doctoral program

At the doctoral level the Review Committee also wished to see some opening out of the student's perspectives. It recommends, much as at the masters level, that students should have an advisory committee including membership from outside their immediate research group. At the 18-month stage, this committee should be responsible for assessing the student's progress. The student should submit a short written report on the proposed thesis research, and then undergo an oral examination on the thesis proposal and his or her command of the state of the art in the research field. The purpose of this examination should be to determine whether the student is set on a productive research course.

The vast majority of doctoral theses are already written in English, but this should be mandatory for an institution of international standing such as The University of Tokyo.

2.4 Education in scientific communication

Attention must also be given to helping students develop their communication skills in both writing and speaking in both Japanese and English. The Review Committee feels that communication skills are best developed within small seminars, and recommends that students at both masters and doctoral level regularly make short presentations in Japanese (at masters level) and in English later. Assessment procedures should use peer criticism, i.e. evaluation by the students themselves. Checklists might be used to structure responses; experience elsewhere suggests that simplicity is the key in any such approach.

2.5 Female students

Special efforts should be made to encourage female students to major in earth and planetary science. One possibility that has been successful elsewhere is to have open house days especially for female students, to introduce them to opportunities in Earth and Planetary Science.

2.6 Foreign graduate students

A larger proportion of foreign students (e.g. 25%) would be desirable to enhance the research profile and international collaborations of the department (e.g. by acceptance of students from collaborating laboratories). For many students the Japanese language is a major hurdle, since it is required to follow the courses at the graduate level.

However, it has to be recognized that it will be difficult to achieve this goal unless there is a change in the current support arrangements. A more systematic program of national funding arrangements for international students is required which will allow support for candidates with excellent academic records (rather than quotas by country).

2.7 Postdoctoral fellows

One of the issues that needs to be addressed in adjusting to the new emphasis on graduate level education is also the need for an element of counseling and career advice at the postdoctoral level. Increasingly, tenured research associate positions are being superseded by temporary postdoctoral positions. Teaching aptitude and skill should be developed by a limited amount of teaching involvement for all staff at the research associate or postdoctoral level, including those in temporary positions.

Many postdoctoral staff will aspire to eventual academic positions but some will have to seek employment outside academia. The new Department must develop effective knowledge and links to industry and commerce to ensure that junior staff can develop their careers effectively. Individuals should not be allowed to remain for an extended time in postdoctoral or research associate positions in the hope of obtaining a professorial faculty position. Career counseling should be introduced, perhaps by using methods similar to those advocated above for counseling at the masters level.

2.7.1 Foreign postdoctoral fellows

A very effective means of enhancing international exchange, thereby usefully broadening the range of points of view to which students are exposed, is through foreign postdoctoral fellows. Comparatively little use appears to have been made of the various exchange agreements administered by JSPS or the main JSPS competition for foreign postdoctoral fellows. The new Department should be encouraged to make more use of such arrangements.

3 Research groups

The reorganization should have the effect of enhancing the research level of the new Department. As stated below in the reports on individual research groups, the quality of the core faculty members of the proposed new Department is generally high, and many of them reach a high international level. However, some of the faculty only reach a reasonable national level and need improvement in the quality of their research.

For those faculty members whose performance is below the norm, certain problems appear to be common. These include a slow publication rate in English, especially in leading international journals, limited efforts to seek external funding, or limited involvement in the key professional

societies and international meetings in their field of specialization. In a few cases it appears that research activity has become rather routine.

The Review Committee recommends that senior faculty make systematic efforts to monitor the performance of junior faculty. Ideally the senior faculty should identify problems of the above type at an early stage, and offer counseling to the junior faculty member, thereby allowing his or her career to be put back on track. If the senior faculty wait too long before intervening, the problems tend to become steadily worse, and it becomes increasingly difficult for the junior faculty member to correct the problem.

The following sections on individual research groups have been prepared by subgroups of the Review Committee. No attempt has been made to make cross-comparisons, and these comments should not be used for this purpose. The structure of the proposed research groups represents a radical restructuring of the current structure of four independent departments, and comparative review of the groups in the new structure may be merited at a later time.

In any review the range of expertise and strengths and weaknesses of the Review Committee themselves play some role. This is most evident in the assessment of research groups with programs that cover a very broad set of disciplines. In any organization, however, self-criticism with well defined criteria will lead to improvements. The comments on individual research groups in the following sections are put forward in this spirit.

3.1 Oceanic and Atmospheric Science Group

3.1.1 Level of attainment of faculty

The Oceanic and Atmospheric Science Group is publishing (in international journals) highly original contributions on the dynamics of general circulation, eddies, and their mutual interaction. Examples include the elucidation of the dynamical mechanisms that are responsible for the absence of seasonal variation of the Kuroshio. Other contributions include a systematic approach towards understanding the dynamical mechanism of super-rotation in the Venusian atmosphere. This group is conducting world-class research, and is strongly involved with international research programs.

3.1.2 Assessment of the respective subgroups

This group is particularly strong in theoretical and computational geophysical fluid dynamics, over a wide range of time and space scales in both oceans and atmospheres. It is highly interactive on an international level, and thus attracts frequent visits from highly-regarded international colleagues. The group participates regularly in international conferences.

The interactions between the subgroups could be improved. For example, ocean-atmosphere interactions exist on many time and space scales, offering potential collaborative efforts on phenomena in addition to climate variability and change. This group has used observations to evaluate models and gain empirical understanding. The members have relatively recently started developing stronger linkages to observational programs. This should be further encouraged.

3.1.3 Funding

Considering that this group's present research activity does not involve making observations, its level of funding is relatively high. The research is computationally intensive, but adequate remote supercomputer resources are available through the University and external institutions. However, the local computational resources (workstations and network) should be upgraded if at all possible. These are critical resources for this group, and they should be maintained and upgraded at regular intervals. The present space for the shared equipment is inadequate, as such equipment requires sufficient ventilation and must be kept cool for maximum life.

3.1.4 Relation to affiliated institutions

Closer collaboration with the Center for Climate System Research (CCSR) and the Ocean Research Institute (ORI) is highly desirable.

3.1.5 Participation in large research projects

This group is strongly involved in the planning and implementation of the World Climate Research Programme and its Climate Variability and Predictability Programme.

3.1.6 Age distribution, inbreeding, etc., of faculty

The faculty of this group are relatively young and energetic. Despite the fact that most faculty received their D.Sc. degree from The University of Tokyo, inbreeding is not a problem. Some junior members of the faculty received degrees from institutions other than The University of Tokyo, including one from a highly-regarded (in atmospheric sciences) US institution. Many members have had research positions at institutions outside of Japan. This is helpful in encouraging an international perspective.

3.1.7 Long-range plan

Increasing emphasis should be given to modeling, theoretical and diagnostic studies of the dynamics of the coupled ocean-atmosphere system. It is important to clarify the long-range plan regarding the Ocean-Atmosphere Material Circulation Physics subgroup.

3.2 Space and Planetary Science Group

3.2.1 Level of attainment of faculty

The new space and planetary science group covers a broad spread of science. The two leading professors in space physics stand out and clearly have high international recognition. Work throughout this group achieves international attention, as can be seen from the range of publications.

3.2.2 Assessment of the respective subgroups

There are five subgroups. Several have substantial experimental activities, and the level of technical support and infrastructure leaves strong cause for concern. Experimental activity is a key element in broadening the group's overall span and what it can offer on the training front. The SIMS work and the UV camera activities are examples of work in internationally competitive areas. The SIMS laboratory is now in a position to be internationally competitive, but support is critical. Mechanisms should be sought in order that key faculty be given appropriate support for experimental work, so that they can maximize their research output. There is a limited capacity to use graduate students and postdoctoral workers for support but there is some danger in any approach that relies entirely on this approach.

3.2.3 Funding

The research funding of the group is similar to the levels typical elsewhere in the department. However, the group has major experimental facilities, some of which should be updated and upgraded. Ways should be found to ensure that these activities, which are important to the department as a whole, are maintained appropriately.

3.2.4 Relation to affiliated institutions

The group is working in an area where links to national institutes and resources are essential. The group has a good and effective participation in Japan's space science program through its links with The Institute of Space and Astronautical Science (ISAS). The links to ISAS are well-developed and appear to be mutually appreciated and secure for the future. There are also links to the Laboratory for Earthquake Chemistry (LEC) of the Graduate School of Science and the Earthquake Research Institute (ERI). In addition, collaborations with the National Astronomical Observatory (NAO) and the Institute for Cosmic Ray Research (ICRR) should also substantially expand the range and effectiveness of the group.

3.2.5 Participation in large research projects

The links to ISAS are sound and form the basis of current activity on a large scale.

3.2.6 Age distribution, inbreeding, etc., of faculty

Both professors in the space physics subgroup have recently been recruited to the university from outside and are of extremely high quality. There must be some concern about research associates in the group whose productivity, although finite, seems limited. As discussed above in section 3, this also appears to be the case in some of the other groups.

3.2.7 Long range plan

One of the challenges will be to integrate the very diverse groups that currently are being brought together, although this clearly fits with the wider aims of the new Department. The group recently has exploited well the present ISAS space missions, such as Geotail and Yohkoh. In the longer term, the group should probably modulate its interests to maximize its collaborative efforts with ISAS and other programs and large scale activity. Furthermore, given the spread of skills and interest in this group, they should actively seek links to other groups of the new Department. Even the strongest activities can gain from a cross-fertilization of ideas.

3.3 Earth and Planetary System Science Group

3.3.1 Level of attainment of faculty

Levels of international excellence are apparent in the Dynamics of the Earth's Surface Environment, Analysis of the Earth and Planetary System, and Dynamics of the Earth System subgroups.

3.3.2 Assessment of the respective subgroups

This group represents the central element binding the other more diverse groups of the new Department. It will play an essential role in the new department and is not redundant, although it overlaps with other groups. The Analysis of the Earth and Planetary System and the Dynamics of the Earth's Surface Environment subgroups show ability to organize and conduct large national and international research projects. These efforts would be assisted by additional supporting staff. This group includes no "system science" modeler. This would be a desirable addition to the faculty to increase the coherence of this group.

3.3.3 Funding

The funding of this group is perhaps an order of magnitude greater than the average per faculty member in the other groups. This remarkable level of funding is due to two very large national projects. A significant part of these funds is used to directly develop and acquire equipment, much at institutions other than the new Department. In the absence of these exceptional contributions, the level of funding would be at about the average for the rest of the proposed department.

3.3.4 Relation to affiliated institutions

There are strong collaborations with ERI, ORI, the Graduate School of Frontier Sciences (GFS), and ISAS.

3.3.5 Participation in large research projects

This group leads several very large national research projects. It also is effectively collaborating internationally on the study of impact events at the K/T boundary and an Asian monsoon experiment.

3.3.6 Age distribution, inbreeding, etc., of faculty

The age distribution is from 35 to 55. This includes primarily associate professors and needs expansion at the younger levels. All faculty received their doctoral degree from The University of Tokyo. From an international perspective this is quite inbred. However, all faculty have spent significant time at other institutions and this group is successful scientifically. Hence, we see no obvious negative effects of this degree of inbreeding.

3.3.7 Long-range plan

Earth system science is currently a dynamic field internationally and the plan of this group is forward-looking but could be broadened. The long-range plan should address the linkage between space and earth physics, such as the solar cycle-terrestrial climate connection. The role of the cryosphere cannot be neglected in the research and graduate education of the new Department. The new Department should consider whether appointments in these fields should be made in the Earth and Planetary System Science Group or in various of the other groups.

3.4 Solid Earth Science Group

3.4.1 Level of attainment of faculty

A number of the faculty are very productive and internationally competitive, and most of the remainder are clearly at a high national level. However some members of the staff have relatively low publication rates in English. Publication of material in English (particularly in international journals) is important.

3.4.2 Assessment of the respective subgroups

The core faculty are strong in the physical aspects of solid earth science such as seismology, geodynamics, and petrology. However this group is weak in the area of geochemistry. Understanding of the nature of the solid earth requires the inclusion of geochemical information. Research and teaching in the solid earth sciences would be enhanced by the inclusion of geochemistry.

The group is composed of scientists from three different methodologies - currently theory (4), field oriented work (4) and experimental (1). The group is strong in theoretical studies. Strengthening of experimental work will be needed to make a major contribution in areas such as the exploitation of synchrotron facilities.

The topic of Earthquake Physics is clearly important in Japan, but there is a danger that the activity could become too narrowly focussed and disconnected from broader developments in seismology. In particular, a potential weakness is the isolation of the current work from observational studies.

The activities on the Structure of the Earth's Interior are significant but only cover a limited range and appear at this stage to have limited interaction with the work on dynamics. It would be desirable for these activities to be better linked to those on the Dynamics of the Earth's Interior, through the new appointment.

The program in Global Tectonics provides insights into global scale tectonic evolution, mountain building processes, and fabric development in seismogenic zones and has achieved high international visibility.

3.4.3 Funding

The general level of external funding for members of the group appears to be adequate but the distribution of funds is rather uneven.

3.4.4 Relation to affiliated institutions

There is significant interaction with ERI in the area of graduate teaching and research training. Cooperation with ORI is also important, particularly in support of the research and teaching in the area of Global Tectonics.

However, it would be desirable to have a more coherent development of the Solid Earth component of the Graduate School of Science to provide a focussed program that is internationally competitive and can sustain the reputation of The University of Tokyo.

Interaction with the LEC should be enhanced to bring in their expertise in geochemistry into the group. The University should give serious consideration to the possibility that part of the LEC be incorporated in the new Department.

3.4.5 Participation in large research projects

The group has a modest involvement with the Ocean Hemisphere Project on a national scale, and links also to national programs in Earthquake Prediction, Volcanic Eruption Prediction and the Earth Simulator Project.

Members of the group have also been involved with the Ocean Drilling Program (ODP) in various ways, including as a co-chief scientist of one leg.

3.4.6 Age distribution, inbreeding, etc., of faculty

The age profile of the group shows a concentration close to the age of 40 at several levels. The group shows a reasonable diversity in the educational backgrounds of the faculty, although only two obtained their doctorate at other universities.

3.4.7 Long range plan

The current plan for the group provides good coverage of the solid earth and its surface processes through the structure of six subgroups. The general directions of the components are

well defined but some of the cross linkages should be reinforced. It is important that a geochemical component be introduced either by future faculty appointments or by collaboration with geochemists in other institutions.

It would also be desirable for the work on the solid earth to have increased interaction with material scientists.

3.5 Geosphere and Biosphere Science Group

3.5.1 Level of attainment of faculty

In general this group's faculty are at an internationally competitive level. The senior professors are active internationally, with sustained records of productivity. The research activity of the four associate professors and the junior research associates is evidenced by their publications in appropriate international journals.

3.5.2 Assessment of the respective subgroups

Evolution of the Geosphere: Leader has excellent geologic background and ability, but may be too geochemically oriented, requiring greater input from the field of physical sedimentology (suggest interaction with the subgroup working with the dynamics of the Earth's surface environment).

Geosphere Material Science: Subgroup has strong mineralogical approach, but needs to have greater interaction with the Biosphere Material Science subgroup in defining experiments.

Chemical Evolution of the Geosphere: Subgroup has an excellent research concept, but needs to interact more with Evolution of the Geosphere subgroup.

Biosphere Material Science: Subgroup has dynamic researchers developing a fundamentally new discipline of geo-molecular biology.

Paleobiology: Subgroup has high ability and potential to foster collaborative research within the Group.

It is critical that the new professor for the Biosphere Material Science subgroup have a strong background in either organic geochemistry or biogeochemistry. Research associates are needed for the Geosphere Material Science and Paleobiology subgroups.

3.5.3 Funding

The funding within the Group is good overall, with each subgroup's having roughly comparable funding. Depending on the subgroup, this is the result of either a single individual's success or the joint contribution of two individuals.

3.5.4 Relation to affiliated institutions

Good co-operation is already established with ORI, the High Energy Accelerator Research Organization (KEK) in Tsukuba, GSAS, and the University Museum. Collaboration should be further strengthened.

3.5.5 Participation in large research projects

Active participation is already established with international projects such as ODP, the International Geosphere-Biosphere Programme (IGBP), projects of the U.S. National Space and Aeronautics Administration (NASA), and the International Geological Correlation Programme (IGCP). In order to enhance international contributions, new projects should be proposed based on the Group's achievements.

3.5.6 Age distribution, inbreeding, etc., of faculty

The receipt of doctorates ranges from 1976 to 1996. Most of the doctorates were earned at The University of Tokyo, but several faculty members received their doctorates or at least part of their education from other Japanese universities. Several others spent extended periods abroad in post-doctoral or advanced study programs. One doctorate was granted by a foreign university. This diversity is a positive factor.

3.5.7 Long-range plan

The Group as a whole has the vision of linking the study of the biosphere with the study of the geosphere. This area, broadly speaking, is a new field in earth sciences called geomicrobiology. Delineating the boundary between biotic and abiotic processes and studying the interaction between organic and inorganic phenomena will provide insight into many unresolved questions. The microbial factor has too long been the missing component in the equation. This work will require research on a sub-micron scale from a mineralogic viewpoint, as well as on the molecular level from the microbial viewpoint. Working hypotheses must be tested both in natural environments and by geomicrobiological laboratory experiments. The link to the geological and paleontological record must be maintained in order to provide the necessary boundary conditions.

The well-organized scope of the research plan for better understanding the "humanosphere" is to be applauded, as this will be an important component of geosphere-biosphere research in the 21st century. The research of the subgroups is multidisciplinary and will require close interaction. A reorganization within the Group and among the various Groups of the full Department will probably be necessary within 5 years.

In order to fully realize its goal of creating a leading program in the field of geosphere-biosphere interaction, it is necessary for this Group to cooperate closely with the Dynamics of the Earth System subgroup and the Dynamics of the Earth's Surface Environment subgroup of the Earth and Planetary System Science Group.

4 Administration

4.1 Faculty

4.1.1 Group structure

1. In the plan for the new Department, some of the subgroups could reasonably be placed into more than one of the research groups. The present placing of subgroups should be re-examined after a few years to determine whether changes would be desirable.
2. Each of the proposed groups should have a "Group Leader," who would serve for a term of not more than 3 years, to ensure the coherence of each program.
3. It is recommended that the organization of groups be reevaluated whenever it is appropriate.

4.1.2 Quality, size, age distribution, inbreeding, etc.

1. Young Research Associates and Associate Professors should be encouraged to seek positions at other institutions to avoid inbreeding.
2. It is desirable for graduates of The University of Tokyo hired by the new Department to have spent time elsewhere prior to appointment.

3. In order to optimize career possibilities for graduates of the new Department, every effort should be made to ensure that JSPS Postdoctoral Fellowships are held elsewhere.
4. Recruitment of more female faculty should be encouraged.
5. The faculty needs to be more international. It will be necessary to provide training in the Japanese language to newly hired foreign faculty.
6. In view of the critical shortage of Research Associate positions, it is recommended that the number of untenured Research Associates be increased. The term of appointment should be long enough for the appointees to be able to perform the tasks which are currently being carried out by tenured Research Associates.

4.1.3 Procedures for appointments and promotions

1. The procedures for appointments and promotions seem reasonable in general. However, the accelerated process needed for the present professorial search poses a considerable strain.
2. The Review Committee recognizes the need to fill as many professorial slots as possible in connection with the formation of the new Department. However the future direction of the Department may be constrained too rigidly if many senior positions are filled prior to the reorganization. When no clearly outstanding candidate has been identified, appointments should be postponed until a suitable candidate is identified.

4.1.4 Other

1. Research conditions should be improved by increasing the time available for research, especially for younger faculty members.
2. To reduce the administration burden on each faculty member, most routine items should be decided by the chairman of the new Department or the group leaders. The post of a secretary (personal assistant) to the chairman should be created to ensure that the chairman has sufficient administrative support.
3. It is strongly recommended that a system of faculty sabbaticals ("Leave for outside study") be set up.

4.2 Supporting staff

1. It is strongly advised that the technical support staff be enhanced (see sections 4.4 and 5.3.3 for details).
2. Funding for increasing the number of teaching assistant and research assistant positions (graduate students who are appointed for one semester or one year) should be increased to improve the quality of education and research.

4.3 Long-range plan

1. Specific mechanisms are needed to facilitate collaboration between groups.
2. It is important to set up procedure for modifying the structure of the new Department in response to changes in external and internal factors.

3. As earth and planetary science evolves, a broad range of new disciplines are becoming increasingly important. The new Department should continually be considering the possibility of expanding into such new areas.
4. It is suggested that scientific symposia be organized within the new Department at which faculty can discuss their proposed future research with their colleagues. Such internal symposia should play an important role in deciding the long-range plans of the Department.
5. Review of the organization is essential after 7-10 years.

4.4 Organization and operation of office

Due to the steady reduction in the number of civil service employees, the number of permanent supporting clerical staff has become insufficient. The existing four departments have hired additional staff of a high quality on a contract basis. However, the cost of employing part-time supporting staff has greatly impacted the budget for routine operating costs ("koho," which is essentially a block grant). Because of this, the amount of block funding from the university that can finally be allocated to each faculty member after all common costs are paid is only 0.3~0.5 Million yen per faculty member (the same amount is allocated to both professorial faculty and research associates).

The present reorganization could possibly improve the efficiency of utilization of the supporting clerical staff. However, the number of permanent supporting clerical staff and technical staff should not be reduced in response to the present reorganization, because the faculty needs more support to achieve better performance in education and research in the new Department. The widely separated locations of the buildings (Bldgs. #1, #3, and #5) also produce difficulty for efficient operation of the new Department. Centralization of the faculty and graduate students in a single building would significantly increase the productivity gained from any staff additions.

It is extremely important to increase the number of the supporting clerical and technical staff by more than 100% for this Department to be a leading and internationally competitive institution. The Review Committee emphasizes strongly that clerical and technical support are essential for an internationally leading educational and research institution.

Another point to be stressed is that organization and office operation performance should also be internationally competitive. It is strongly recommended that the clerical staff and secretaries should have the capability to communicate with foreign scientists and students. Writing and speaking skills in English in the office are indispensable and staff should be encouraged to improve their English skills. This point is also essential to enable the new Department to communicate smoothly with organizations and individuals outside Japan.

5 Facilities

5.1 Buildings

Centralized research and educational facilities are critical to the long-term success of the new Department of Earth and Planetary Science. The distribution of the faculty among three buildings results in a physical separation which is a major impediment to collaboration in research and education within the new Department. The wide distribution of facilities such as libraries and lecture rooms provides an important hindrance to the faculty and students of the new Department. It is strongly recommended that a new building be constructed adjacent to Building #1 to provide the new Department with the possibility to achieve its potential.

It should be stressed that proper maintenance of existing space is important to ensure safety, cost efficiency, and the morale of the personnel of the Department. Working conditions for staff and students housed in the older buildings are not good. In part, efforts can be made by the Department to encourage good care. University-wide funds for routine maintenance are limited, but attention should nonetheless be directed to the issue.

5.2 Teaching facilities

Lecture rooms are distributed among three widely separated buildings. The space allocated to the new Department in Bldg. #1 does not have lecture rooms large enough for most courses, so that they must be taught in other buildings, primarily Bldg. #3. Thus, both students and faculty must spend considerable time moving between buildings.

Three libraries presently exist, two in Bldg. #5 and one in Bldg. #3. There are three librarians. Faculty in Bldg. #1 have to walk about 5 min to access one of these collections. It would be highly desirable to combine these collections to reduce the number of librarians needed and to eliminate redundancy in increasingly expensive journal subscriptions. However, this may be difficult until the faculty and student offices are centralized in one location.

An increasingly important element of higher education is the use of computers in the classroom to allow teaching of computer-based research methods. The new Department will have some facilities for such teaching, but it is important to steadily upgrade them as new equipment becomes available.

5.3 Research facilities

5.3.1 Common facilities

Libraries: See the comments under Teaching (above) regarding the library facilities which are essential to both education and research.

Computing: Computational facilities are essential for numerical modeling, data analysis, data processing, and data management, which are critical components of the research of the new Department. The centralized facilities of The University of Tokyo are apparently not used very much. In part, this is because of the increased capability of personal computers and workstations. Groups that do need substantial computing power are not well-served by the University facility at present. The present switch from a vector-processing machine to a massively parallel machine requires a substantial amount of recoding in order to realize the potentially larger power. Such recoding is time consuming and technically demanding. The use of centralized University computing for research will continue to decline unless relatively high levels of technical support are provided for this purpose. Some researchers are using outside facilities, such as those at Affiliated Institutions and other external facilities. With increasing dependence on workstations, personal computers and local networks, it is important to maintain and upgrade these facilities on a continuing basis. This requires that obsolete computing equipment be upgraded and department-wide support provided for hardware and software maintenance and upgrading (funding and technical support).

Data Management: Facilities for centralized data management are needed for a world-class education and research environment in the new Department. This includes World Wide Web servers. This is one area where technical support is highly important, because the technologies are changing so quickly and because it is a poor use of student and faculty time to attempt to provide this support.

5.3.2 Specialized Laboratories

The present departments have a large number of laboratory and analytical facilities, a few of which are high quality. However, many of them are in desperate need of upgrading to ensure a safe and high-quality research environment. Regulations should be changed where necessary to allow funds to be used to upgrade facilities.

5.3.3 Technical Support

High quality technical support, in sufficient quantity, is absolutely essential to providing a productive, world-class scientific research effort. Additional technical support personnel are needed to support the advanced research of the new Department. Mechanisms must be found to allow hiring of additional technicians from external grant funds. Additional funds should be provided for technicians who provide general support. Such technicians should in general be contract employees rather than permanent civil servants.

The Review Committee asks the Dean of the Graduate School of Science to call the above to the attention of Monbusho and the central administration of The University of Tokyo, and request that action be taken to address these points.

6 International exchange

Issues related to foreign graduate students and foreign postdoctoral fellows are discussed above in sections 2.6 and 2.7.1 respectively.

6.1 Permanent foreign faculty

The number of permanent foreign faculty is extremely small. To sustain The University of Tokyo as a major international university, it is essential to broaden the background of the faculty. Foreign faculty can bring with them different attitudes and ways of thinking in research and teaching that are particularly valuable in the graduate level courses.

A challenge for the recruitment of foreign faculty is posed by the Japanese language. Although it is possible for advanced teaching to be undertaken in English, faculty members are not able to participate fully in the life of the Department until they have reached a reasonable standard in Japanese.

Intensive language training should be provided to enable foreign faculty to be able to take up full duties in the Department as soon as possible. Continuing help may be needed for faculty recruited in particularly important subjects so that their research productivity can be maintained.

6.2 Visiting foreign faculty

Visiting foreign faculty are not required to have Japanese language skills and can help with enhancement of research activities. However, because of the short duration of such posts, they may not be attractive to foreign scientists unless they provide access to facilities not available elsewhere.

6.3 Research collaboration

Many of the current members of the departments have strong international links and these should be maintained, and, where suitable opportunities arise, enhanced. One significant means of forging broad international links is via participation in major international programs. This

has the advantage of enhancing foreign contacts and bringing visitors (students, postdocs and staff) to the Department.

For example, Japanese participation in the ODP (particularly by University of Tokyo core and affiliated faculty) has led to excellent collaborations and made significant contributions to international science. UT faculty should continue their involvement in major international scientific programs and in the definition and planning of future programs.

A visiting scientist program would be a useful addition to the international interactions of the new Department and would help to cement existing links. Use of the Japan Society for the Promotion of Science (JSPS) exchange programs and the JSPS Invitational Fellowships would be a useful measure until suitable funds can be identified. It is also important to obtain sufficient office space to house the visiting faculty.

7 Funding

The amount of internal funds available for research is very small. In order to insure availability of sufficient research funds, which is necessary to increase the research productivity of the new Department, the Review Committee recommends that as soon as possible after it is officially formed, the new Department should apply for a competitive Monbusho grant for a Center of Excellence (COE). The availability of such funds would enhance the close interdisciplinary collaboration which is essential for the successful execution of research projects.

It is important for the new Department to create seed money to support young scientists of outstanding ability. The Review Committee does not wish to prescribe any particular method for obtaining such funds, but does wish to stress that such funding is important for "jump-starting" the research of young faculty members of the new Department.

International best practice recommends that 5-10% of the value of equipment be spent on maintenance on an annual basis. More flexible rules for expenditure of research grant funds are needed to ensure optimal operation of expensive equipment and to provide technical support. The Review Committee recommends that Monbusho take action regarding this area.

Budgetary regulations make it impossible to carry unspent research funds over to the following year. The Review Committee asks the Dean of the Graduate School of Science to request that steps be taken by Monbusho to permit grant money to be spent over a period which is longer than a single fiscal year, so that the use of funds could be optimized.

8 Relation to society

The new Department is in a unique position to play a pivotal role in assisting society with environmental and resource problems which will become increasingly significant in the 21st century. Topics in which the new Department could contribute its broad expertise include the study of geologic hazards, such as earthquakes, volcanic eruptions or slope instabilities; the search for possible new sources of energy; exploration for new sources of natural building materials, such as sand and gravel; natural and anthropogenic processes driving climate change, and the consequence of these changes, as recorded in the geologic record; and techniques for renewing and/or preserving groundwater reservoirs. The reorganization of the Department with an emphasis on a multidisciplinary earth system science approach to teaching and research demonstrates a strong awareness of these problems and a desire to contribute solutions through relevant education and research.

To accomplish the above goals, the new Department should establish a mechanism for obtaining opinions from appropriate individuals in the outside community that can be reflected in its general policies. It would be appropriate for the new Department to establish an Advisory

Council with extensive external representation, including members from industry. The role of the proposed Advisory Council would be complementary to that of Review Committees of the type issuing this report, which will be convened only at intervals of 7-10 years. The Advisory Council should meet at regular intervals to perform the following tasks: (1) review and evaluate the research and educational activities of the Department; and (2) identify and recommend steps for enhancing research productivity and improving the quality of education. The Advisory Council should report to the Dean of the Graduate School of Science as well as to the new Department.

Another possible mechanism to facilitate the flow of information between academia and industry would be for the Department to offer annual short courses on new technologies and approaches to the study of problems in earth and planetary science which would bridge the gap between fundamental and applied science. In addition, the Department should determine the type of education and training that will be needed to prepare its Masters graduates to better find positions in non-academic sectors and to contribute their expertise to solving the challenging environmental and geological problems of the 21st century.

To educate the general public, the Department should establish regular communication through the written and broadcast media to inform the public of the research that is being conducted by its faculty and students. The Department could hold a series of open lectures at the University to inform the interested public. An interactive web site could be developed to reach and educate a wider, possibly younger, audience with the message that earth and planetary science is both exciting and relevant. This web site could report on on-going research projects within the Department and provide links to other web sites that provide information to the public regarding earth and planetary science and related fields. Such web sites include both those of other universities and research institutes and those providing data on events such as solar maxima, planetary fly-bys, El Niño, tsunamis, and earthquakes.

9 Review system

All members of the External Review Committee believe that the present review was productive owing to the extraordinary efforts by the staff of the earth and planetary science departments in organization and preparation of background information. Comprehensive presentations on the ongoing research, education and administration as well as the future prospects after the reorganization helped the Review Committee members understand the need for the reorganization.

It is recommended that the new Department should be given the opportunity to provide the university administration with a rapid response to the present review and its recommendations. Following common practice overseas, the initial response should be followed at an interval of 2-3 years by a formal report from the Department indicating the extent to which the recommendations of this review have been implemented. A detailed explanation should be presented in cases where the recommended course of action has not been followed. At this "three year" response the Department should also report on the evolution of the group structure and education plan from the present proposal.

The "three year" response would also provide an opportunity to assess the need for any future large-scale external review like present one. A convenient cycle to maintain quality without undue interruption would be 7-10 years.

10 Final Program for Review Committee Meeting

- Sunday March 14, 1999

- 1900-2100 Welcoming party, Sofitel Hotel

- Monday March 15

- 0800-0900 Breakfast (Review Committee + some faculty, at Hotel)

- 1000-1220 Meeting (All meetings in Bldg. No. 1 of Graduate School of Science)
Meeting from 1000-1140 in Room Number 206, 2nd floor

- * 1000-1010 Prof. H. Suematsu, Dean of Graduate School of Science (Introduction)

- * 1010-1100 Prof. Y. Hamano (Overview of plans for the new Department, 40 min + 10 min questions)

- * 1100-1140 Dr. D. Swinbanks, President, Nature Japan K.K. (External Review in Japan, 30 min + 10 min questions)

- * 1140-1150 Break

- * 1150-1220 General discussion of procedures for conducting the review (Chair: Prof. I. Kushiro, Okayama Univ., Chairman of Review Committee), Room number 709, 7th floor. All meetings were held in this room, excepting the poster talks, which were held in Room 710, and the opening and concluding sessions, which were held in Room 206.

- 1230-1315 Lunch (Members of External Review Committee + 10-15 faculty, students, postdocs, at Sanjo Kaikan)

- 1330-1730 Meeting

- * 1330-1500 Space and Planetary Science Group

- 1330-1400 Prof. T. Terasawa, Overview (20 min + 10 min questions)

- 1400-1420 Prof. M. Nakamura (15 min + 5 min questions)

- 1420-1440 Prof. M. Hoshino (15 min + 5 min questions)

- 1440-1500 Dr. J. Newton (15 min + 5 min questions)

- * 1500-1600 Poster Session I (Research presentations by students, postdocs, and junior faculty), Room 710

- * 1600-1730 Oceanic and Atmospheric Science Group

- 1600-1630 Prof. T. Yamagata, Overview (20 min + 10 min questions)

- 1630-1650 Prof. T. Yamagata, Research presentation (15 min + 5 min questions)

- 1650-1710 Prof. Y. Matsuda (15 min + 5 min questions)

- 1710-1730 Prof. T. Hibiya (15 min + 5 min questions)

- * 1730-1800 Further discussion of procedures for conducting the review (Chair: Prof. Kushiro)

- 1900-2100 Dinner (Members of Review Committee plus faculty, students, postdocs, and alumni)

- Tuesday March 16

- 0730-0830 Breakfast (Review Committee, at Hotel)
- 0930-1215 Meeting
 - * 0930-1100 Earth and Planetary System Science Group
 - 0930-1000 Prof. R. Tada, Overview (20 min + 10 min questions)
 - 1000-1020 Prof. Y. Hamano (15 min + 5 min questions)
 - 1020-1040 Prof. R. Tada, Research presentation (15 min + 5 min questions)
 - 1040-1100 Prof. J. Matsumoto (15 min + 5 min questions)
 - * 1100-1115 Break
 - * 1115-1215 Solid Earth Science Group, Part I
 - 1115-1145 Prof. M. Matsu'ura, Overview (20 min + 10 min questions)
 - 1145-1200 Prof. G. Kimura (10 min + 5 min questions)
 - 1200-1215 Prof. Y. Ikeda (10 min + 5 min questions)
- 1230-1315 Lunch (Members of Review Committee + 10-15 faculty, students, post-docs, at Sanjo Kaikan)
- 1330-1530 Meeting
 - * 1330-1400 Solid Earth Science Group, Part II
 - 1330-1345 Prof. H. Iwamori (10 min + 5 min questions)
 - 1345-1400 Prof. R. J. Geller (10 min + 5 min questions)
 - * 1400-1530 Geosphere and Biosphere Group
 - 1400-1430 Prof. K. Tanabe, Overview (20 min + 10 min questions)
 - 1430-1450 Prof. R. Matsumoto (15 min + 5 min questions)
 - 1450-1510 Prof. T. Murakami (15 min + 5 min questions)
 - 1510-1530 Dr. K. Endo (15 min + 5 min questions)
- 1530-1630 Poster Session II (Research presentations by students, postdocs, and junior faculty), Room 710
- 1645-1845 Tour of Facilities and Buildings (Bldgs. #3 and #5 of the Graduate School of Science)
- 1930-2130 Dinner (Members of Review Committee plus faculty, students, postdocs, alumni)

● Wednesday March 17

- 730AM-830AM Breakfast (Review Committee, at Hotel)
- 0930-1200 Meeting
 - * 0930-1130 Prof. R. Matsumoto, Discussion of organization, rules, procedures for faculty appointments, etc. of new department (talk interspersed with questions and general discussion)
 - * 1130-1200 Prof. M. Matsu'ura, Graduate and undergraduate education (Part I of talk, which was interspersed with general discussion)
- 1215-1315 Lunch (members + 10-15 faculty, students, postdocs, Sanjo Kaikan)
- 1330-1800 Meeting
 - * 1330-1430 Prof. M. Matsu'ura, Graduate and undergraduate education (Part II of talk, which was interspersed with general discussion)
 - * 1430-1445 Break

- * 1445-1530 Prof. G. Kimura, Report on current status of faculty search
- * 1430-1800 Session of Review Committee to discuss conclusions and clarify matters of fact (attended by Profs. G. Kimura and R.J. Geller from UT side),
- 1900-2100 Dinner (at Sofitel, Members of Review Committee + faculty)

- Thursday March 18

- 0730-0830 Breakfast (Review Committee, at hotel)
- 0930-1800 Executive Session (Bento lunch) Drafting of report. Check for factual errors by University of Tokyo side, but otherwise all comments are the responsibility of Review Committee
- 1900-2100 Closing dinner (Totenko)
- Changes in draft report made in discussion were typed, and all members of the Review Committee were supplied with an updated version of the draft of the report on the morning of Friday March 19 (draft was left at their hotel rooms overnight, or given to one committee member who did not stay at the hotel when he arrived for the meeting on Friday morning).

- Friday March 19

- 0700-0800 Breakfast (Review Committee, at Hotel)
- 0830-1030 Meeting of Review Committee to complete drafting of report
- 1030-1045 Break
- 1045-1200 Meeting open to all faculty, Room 206
Oral presentation of conclusions of review. Prof. Kushiro presented summarized the recommendations, speaking in Japanese. Prof. Southwood gave presented the Review Committee's conclusions regarding teaching, and Prof. Kennett presented the Review Committee's conclusions regarding research.
- 1230-1330 Lunch at Sanjo Kaikan (Attended by Review Committee, members of internal committee for organizing the review, and supporting staff for the review).
- Close of Review

11 Members of Review Committee

- Prof. Brian Kennett
Research School of Earth Sciences, The Australian National University
- Prof. Ikuo Kushiro (Chairman)
Institute for Study of the Earth's Interior, Okayama University, Misasa
- Prof. Roger B. Lukas
Dept. of Oceanography, University of Hawaii
- Prof. Syukuro Manabe
Institute for Global Change Research, Frontier Research System for Global Change, Tokyo
- Prof. Judith A. McKenzie
Geological Institute ETH-Zentrum, Zurich
- Prof. J. Casey Moore
Earth Science, University of California, Santa Cruz
- Prof. Jun Nishimura
Yamagata Academy of Technology
- Prof. Eiji Ohtani
Institute of Mineralogy, Petrology, and Economic Geology, Faculty of Science, Tohoku University
- Prof. Hakuyu Okada
Oyo Corporation, Kyushu Branch
- Prof. Tetsuo Sasao
National Astronomical Observatory
- Prof. David J. Southwood
European Space Agency (ESA)

Due to the special circumstance that all of the faculty members in planetary science were attending the Lunar and Planetary Science Conference in Houston during the time of the Review, the Review Committee was unable to meet with any of the faculty members in that field. An expert referee in that field (Prof. B. Fegley, Washington Univ., St. Louis) therefore was asked to inform the Review Committee of his view of activity by faculty members in this field. His confidential report was made available to the Review Committee and is indirectly reflected in this report, although he did not participate in the drafting of this report.