Catastrophic Eruption of Mount St. Helens Volcano

Aerial view of the full-scale eruption following the explosion on May 18. The billowing plume rose to above 20 000 m into the atmosphere. Estimates suggest that approximately 1 cubic km of material was ejected. (Photo by Austin Post courtesy U.S. Geological Survey)

With a blast that devastated a wide swath 25 km NW of its crater, Mount St. Helens Volcano (Washington, U.S.A.) erupted on May 18, 1980, stripping trees and up to 2 m of soil from hillsides and hurling them into the lee of ridges. The explosion was heard 300 km to the north in British Columbia, Canada.

The international significance of the eruption is major. The amount of information gathered on the geological and tectonic setting of Mount St. Helens in the past, the observations and data collected on the eruption itself, and the continuing detailed analysis of its activities and effects make this one of the best documented volcanic explosions to date, and will undoubtedly assist geologists in making even more precise predictions in the future.

As early as 1975, U.S. Geological Survey (USGS) scientists had identified Mount St. Helens as one of the Cascade volcanoes most likely to reawaken from dormancy; D. R. Mullineaux and D. R. Crandell analyzed the expectable kinds of future eruptions at Mount St. Helens and assessed their possible effects on human life and property.* Through such predictions, the death toll at Mount St. Helens was much less than it might have been. What no one could have predicted was the magnitude and the unusual directionality of the phreatic explosion.

The May 18 blast covered the devastated area with ash that swept the ridges, collected in valleys, and flowed down the local drainages (Fig. 1). A second component of the event was a combined pyroclastic flow and landslide that carried

* Crandall, D. R. and Mullineaux, D. R., 1978, Potential Hazards from Future Eruptions of Mount St. Helens Volcano, Washington: U. S. Geological Survey Bulletin 1383-C, 26 p.

Figure 1. Blast of eruption blew down trees up to 25 km NW of the crater. (Source: U.S. Geological Survey)

material released by the catastrophic failure of the volcano's north flank across its lower slope and about 30 km down the Toutle River Valley, burying it to depths as great as 60 m. The third component of the blast was a pumiceous pyroclastic flow that funnelled northward through the breach in the crater formed by the north slope failure. This deposit formed a barrier that raised the water level by 30 to 50 m, and the lake continued to rise behind the debris dam.

After the initial rapid series of events, the volcano continued to erupt an ash column to altitudes of 20 000 m for several hours, generating a plume at high levels in the atmosphere that has deposited ash more than several cm thick as far east as central Montana and continued to deposit detectable amounts of ash over the central United States and Canada into late May (Fig. 2). Both the initial blast and the subsequent mudflows and floods down the Toutle River caused heavy damage and are presumed to have resulted in the deaths of 96 people.

Figure 2. Distribution of ashfall in mainland U.S. from May 18 eruption. (Source: U.S. Geological Survey)

An important remaining hazard results from the debris dam at Spirit Lake which could be breached by the rising water. Rapid release of this water could cause even larger floods down the Toutle River, and the saturated debris filling the upper part of the valley could generate large mudflows farther down the valley.

Geological Portents of Eruption

Mount St. Helens had been dormant for almost a century when it re-awakened on March 20, 1980 with a swarm of earthquakes up to a magnitude of 4.1 on the Richter scale prior to the initial eruption a week later. From March 30

through March 26, the Newport, Washington station recorded more than 30 tremors that ranged in magnitude from 3.4 to 4.2. Most of these, and hundreds of smaller quakes, were centered near the volcano at relatively shallow depths of about 5 km or less below the land surface. For example, 24 earthquakes of magnitudes 3.4 to 4.0 were recorded during March 25 and 26.

Early on March 27, before the first eruptive outburst was reported, the USGS began issuing a formal "hazard alert". The first eruption occurred during the afternoon of March 27, when the volcano explosively ejected a volume of ash and steam. The USGS Newport station recorded a magnitude 4.5 earthquake, the strongest up to that point. Shortly afterwards observers saw a new crater, about 60 to 80 m in diameter and 50 m deep. They also noted considerable deformation in the ice, snow, and rocks around the peak and a swath of dark volcanic ash across the crater and down the volcano's NE slope. In addition, two east-trending cracks had formed in the summit area, one about 5 km long and the other about 1.5 km long.

By now, scientists had arrived from USGS offices in Menlo Park, Denver, Tacoma, and Seattle as well as from various neighbouring universities to monitor the volcano's activity. This included aerial and ground-based observations and instrumental monitoring of earthquake activity, deformation of the ground surface, gravity changes, the physical and chemical compositions of volcanic ash and gases, thermal emissions, and changes in the quantity and quality of water runoff.

A second explosion on March 28 produced an ash and steam cloud that rose more than 1.5 km above the volcano as well as an ash avalanche that cascaded down its east flank. By mid-afternoon, at least a dozen explosions had occurred, and columns of steam and ash had reached nearly 3 000 m above the volcano and had drifted eastward.

Vents near the volcano's summit were emitting volcanic ash, steam and other gases. Earthquake activity continued, apparently centered beneath the northwestern part of the volcano at a depth of less than 1.5 km. Nine earthquakes were recorded in the range of magnitudes 3.4 to 4.2 and several ashladen snow avalanches slid down the east flank of the volcano. As a precautionary measure, the U.S. Pacific Power and Light officials lowered the water level in Swift Reservoir to create a capacity to accommodate any eruption-induced snowmelt runoff or mudflows.

By March 29 a second crater was noted within the old summit crater; during the night, the first observations were made of a blue flame burning within the craters and of lightning flashes accompanying ash avalanches. The first analyses of ash samples found no evidence of "juvenile" rock material that would indicate eruption of magma. The ash was composed of pulverized old rock, ejected into the air by steam explosions. The explosive eruptions were thought to be caused by subsurface water within the volcano that trickled down through the rocks and, when heated to the temperature of boiling, expanded violently in sudden bursts of steam. Thirteen earthquakes, ranging in magnitude from 3.4 to 4.2, were recorded on March 29. The USGS established the first tiltmeter station to measure surface deformation that might have been caused by swelling of the volcano as magma moved upward.

On March 30 an anvil-shaped steam and ash cloud formed and produced light ash falls as far away as 250 km to the south. The frequency of the earthquakes decreased somewhat, but the average magnitudes increased, suggesting that the total energy release remained more or less the same. For example, during the night of March 31-April 1, three of the strongest quakes were recorded (magnitudes 4.7, 4.5, and 4.6). Moreover, the first weak burst of harmonic tremor was noted; a continuous release of seismic energy in contrast to the distinct energy bursts of discrete earthquakes, the harmonic tremor is typically associated with the underground movement of magma. All recent volcanic eruptions in

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Hawaii, for example, have been preceded and accompanied by harmonic tremor, but such tremor sometimes also occurs without being followed by an eruption. There was, however, a particularly large explosion on April 1 which deposited ash as far away as Spokane 500 km to the east.

A second, stronger burst of harmonic tremor on April 2 confirmed the recognition of the weaker one the day before and provided the best indication that magma was moving beneath Mount St. Helens. Concerned USGS scientists alerted local and state officials participating in the hazard-watch system. Harmonic tremor was recorded intermittently until May 8; thereafter, none were recorded until the May 18 explosion.

A study of airphotos by James Moore during the last week of April led USGS surveyors to confirm earlier estimates that parts of the upper north flank of the volcano had risen more than 100 m since the beginning of seismic and eruptive activity. Scientists announced on April 30 that the north slope bulge represented the most serious potential hazard to date. Because of the instability of the bulge area and related potential hazards of large avalanches of snow, ice, and rock that could disrupt the highway S and W of Spirit Lake, the USGS issued an updated hazard warning on April 30, 1980.

The graben referred to earlier was related to this swelling. Some geologists believe that the earthquake of magnitude 5.0 on May 18 first triggered the landslide (within the graben) which removed the "lid" to release the explosive eruption.

In spite of the ferocity of the Mount St. Helens eruption, it is estimated to have had only two per cent of the energy of the Tambora (Indonesia) eruption in 1815. On the other hand, it was almost twice as powerful as the Mt. Pelée (Martinique) eruption whose glowing avalanche in 1902 resulted in the deaths of almost 30 000 people.

Looking south toward north face on April 10 showing appearance of an alarming bulge on slope below active eruption. (Photo courtesy U.S. Geological Survey)

New IUGS Publication Series Launched

Two publications under the new IUGS publication series have already been printed (due largely to the initiative of the Chairman of the IUGS Subcommission on Ordovician Stratigraphy, **Dr. Reuben J. Ross, Jr.**) and are available from the IUGS Secretariat at \$6.00 U.S. each. They are:

Publication No. 1: **The Ordovician System in China. Correlation Chart and Explanatory Notes** by Sheng Shen-Fu (May, 1980); and

Publication No. 2: **The Ordovician System in the Near and Middle East. Correlation Chart and Explanatory Notes** by William T. Dean (June, 1980).

The publication series - essentially an informal numbering system - was approved by the Executive Committee in February and put into effect by the Chairman of the IUGS Advisory Board for Publication, **Dr. M. G. Bassett** and the IUGS Secretary General, **Dr. W. W. Hutchison**. Suggested guidelines on identification procedures under the series were circulated to the Chairmen and Secretaries of all IUGS constituent bodies in March, and are reproduced here for the information of anyone contemplating making use of the series:

"A considerable number of volumes of different sorts are published each year as a direct result of activities by IUGS bodies. However, in many cases the IUGS involvement is frequently masked because these publications carry no statement to the effect that they are the result of official work done under the auspices of the Union. At the recent meeting of the IUGS Executive, it was agreed that we should now encourage all those concerned with the production of such volumes to identify them with an informal numbering system.

Under the auspices of the Union many bodies are producing special issues of journals, books, symposium volumes, etc. Anyone involved in the production of such a publication is now asked to identify it preferably both on the cover and the title page with the following statement:

IUGS Publication No.

Numbers will be issued by the Secretary General who will maintain a central register of the numbers. If you wish your publication to be identified in this way as part of the formal

IUGS activities of your group, then will you please write to the Secretary General about eight weeks before your definite deadline for going to press.

If possible, we also ask if you can encourage the publishers to include the IUGS logotype on the cover or title page, or both. The numbered series of IUGS publications will not apply to single papers in the normal scientific periodicals. In these cases, however, we also hope that IUGS activity related to a paper can be identified by a statement in the introduction or some other appropriate place in the text."

Two other publications have been assigned under the new system and should be available shortly - a volume on the Palaeogene/Neogene Boundary, and the proceedings of the IUGS Subcommission on Carboniferous Stratigraphy's Field and General Meeting, held in Turkey in May, 1978.

To facilitate ordering the new IUGS publications, please clip and post the form below.

Please send me:

IUGS Publication No. 1. (The Ordovician System in China) (Price - \$6.00 U.S.)

IUGS Publication No. 2. (The Ordovician System in the Near and Middle East) (Price - \$6.00 U.S.)

— Literature on other IUGS Publications

Name and Address: _____

— My cheque for \$ _____ is enclosed.

— Please bill me

Post this form to: **Dr. V. Lafferty, IUGS Secretariat, Room 177, 601 Booth Street, Ottawa, Ontario, Canada, K1A 0E8**

European Cretaceous Volume Published

Thirty-nine papers on regional studies, correlations, paleontology and stratigraphy and Mid-Cretaceous events presented at a symposium held in Munster, Germany in April, 1978 have just been published in a single volume as Number 6 in *IUGS Series A. Aspekte der Kreide Europas (Aspects of the Cretaceous in Europe)* is available in English or German, has been edited by Jost Wiedmann, Tübingen and honours Clemens Schlüter (1835-1906) for his work on the Cretaceous and in particular on the cephalopods of the Upper Cretaceous in Germany.

The publication comprises 680 pages, 33 plates, 182 figures and 42 tables, and is available at DM 198 or U.S. \$117, from: *E. Schweizerbart'sche Verlagsbuchhandlung, Johannesstr. 3A, D-7000 Stuttgart 1, Federal Republic of Germany.*

Prognosis for Seabed Mining Bleak

A new study conducted by **Mr. Hermann Enzer** (U.S.A.) concludes that the economic prospects of mining minerals from the sea are not bright. While mining executives say they will need a return on their investment of at least 30% to compensate for the risks involved, Mr. Enzer calculates that the return on seabed mining is only about 8%.

The study concludes that although the technology is feasible, costs are too high and the rewards too meagre. Estimates in the 1970's suggested that on the Pacific floor alone there were between 90 and 1,700 billion tonnes of manganese nodules containing on average 32% manganese oxide. As well as the manganese, nodules are rich in nickel, copper, cobalt and molybdenum. Mr. Enzer's study, however, concluded that land-based reserves of nickel and cobalt will satisfy demand for at least the next 25 years at current prices.

The study comes on the eve of the final negotiating session in July of the UN's twelve-year long Law of the Sea Conference.

IGCP Publications Catalogue Available

A combined effort by the IGCP Secretariat and the American Geological Institute (AGI) has resulted in the completion of a catalogue of publications emanating from IGCP Projects. The list was initially prepared by **Huang Zhengzhie** of the IGCP Secretariat in Paris and sent to AGI in Washington in 1979. There, **G.N. Rassam** of AGI checked which publications were already in the GeoRef bibliographic file. For the balance, the time-consuming process of editing began, including seeking out the missing information and correcting errors.

Camera-ready copy of the catalogue has now been prepared by AGI and returned to the IGCP Secretariat for publication. Approximately 4,000 titles are in the file and it is anticipated that the proof copy will be on display during the 26th IGC in July. An index will be compiled during the next six months.

A potential problem lies in the fact that nearly 1,000 titles have been entered based only on the title submitted by the Project Leader. Such references cannot be indexed without access to a copy of the publication and therefore are marked by an asterisk in the catalogue.

All references indexed have been entered into GeoRef and are available now either as hard copy editions of the GeoRef bibliography or for on-line and other searches of the computer file from anywhere in the world. It is hoped that the Catalogue and Index may be updated in GeoRef on a continuing basis and published periodically.

Planned UN Science Centre Short of Funds

At a pledging conference held this spring, some 35 countries pledged just under \$50 million in support of the UN action plan for implementing projects and programs which might advance science and technology in developing countries (see *EPISODES*, Vol. 1980, No. 1, p.46). This is far short of the \$250 million anticipated at the UN Conference on Science and Technology for Development (UNCSTD) in Vienna last fall, and a second pledging conference has been planned for September.

A surprising development was the support given to the fund by many of the poorer developing countries, indicating their faith in UNCSTD's action program. Third World governments, UN agencies and non-governmental organizations have already suggested 200 projects that the fund could support. UNDP is screening these and will be publishing guidelines for applicants. It is anticipated that a team of experts will be appointed to consider long-term financial arrangements for the planned Science Centre.

International Atlas of Ophiolites

Four maps of classical ophiolite areas have been compiled by a working group of IGCP Project 39 ("Ophiolites of Continents and Comparable Oceanic Rocks") and published by the Geological Society of America as the Society's Map and Chart Series MC-33.

The maps comprising the International Atlas of Ophiolites, each at 1:2 500 000 scale include: Sheet 1, Western United States (California, Oregon, and Nevada) by W.P. Irwin, 45 x 52 cm; Sheet 2, Central Mediterranean (France to Turkey) by V.J. Dietrich, 98 x 79 cm; Sheet 3, Urals (U.S.S.R.) by A. Knipper, 26 x 99 cm; and Sheet 4, Himalayan and Tibetan Region (Afghanistan, U.S.S.R. to People's Republic of China, and Burma) by A. Gansser, 75 x 129 cm. The accompanying explanatory text of 15 pages includes three figures, a list of maps used in compilation, and references cited. The text of the Urals map is by A. Perfiliev.

The Atlas shows ophiolites of Phanerozoic age in five age groups: Early Palaeozoic, Late Palaeozoic/Permian-Triassic, Mesozoic in general, Early Mesozoic (mainly Jurassic), and Late Mesozoic (mainly Cretaceous but including early Tertiary). Individually, the maps show no more than three of the five age groups. Eight to 13 rock units directly associated with ophiolites among a total of 15 to 20 rock map units define the occurrences of the ophiolites in space and time.

As examples of ophiolite occurrences, the maps are unique: at a common scale and with comparable lithologic-tectonic map units, comparisons are easily made. The great lineal extent of ophiolites, ranging from 1,000 km in western U.S.,

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2,300 km in the Urals, and more than 3,000 km in the Himalayas, and their widespread occurrence in southern and central Europe from the western Alps to western Turkey, are emphasized by visual comparison.

By differentiating map units in coloured pencils or coloured plastic film and photographing for colour separation, negatives were prepared for four-colour printing. This technique yields less consistent colours than by conventional "open window" printing and there are some uncoloured areas where the plastic film "popped off" in transit, review, and photography. Nevertheless, the resulting maps are legible enough for understanding and comparison.

Ophiolites as mafic and ultramafic components of orogenic belts are generally regarded as remnants of oceanic crust and upper mantle. Knowledge of their distribution, mode of formation, and ages is critical to an understanding of the tectonic history of orogenic belts and in the search for chromium, nickel, copper, manganese, and other mineral commodities associated with ophiolitic rocks.

Preparation and printing of the Atlas was supported by a grant from the Division of Earth Sciences, UNESCO, under IGCP Project 39; the grant was later transferred to IUGS which arranged for publication with the Geological Society of America. The Atlas and accompanying text can be ordered from GSA, 3300 Penrose Place, Boulder, CO 80301, U.S.A. (Cost: \$19.00 - folded; \$20.50 - rolled, surface mail); in Europe, order from: *Office International de Librairie, Ave Marnix 30, BTE 19, B-1050 Bruxelles, Belgium* (Cost: \$21.85 - folded; \$23.60 - rolled, plus postage and handling costs).

Caribbean Plate Project

The U.S. Lunar and Planetary Institute recently established a Caribbean Plate Steering Group, chaired by **K. Burke**, to guide research in the Caribbean area within the interest of the NASA-OSTA Offices of Geodynamics and Non-Renewable Resources.

The Group will treat the Caribbean as a test-case for achieving NASA's goals of attaining (i) a scientific understanding of Earth dynamics through the application of space methods and technology; and (ii) a scientific understanding of the evolution, three-dimensional structure, composition and resource distribution of the crust.

It will assure maintenance of a synoptic study of the Caribbean and ensure that participatory studies make the fullest appropriate use of innovations in remote sensing and potential field and geodynamic measurements. The Group has met twice - in February and in April.

A position paper on the Caribbean Plate Project is in preparation and plans are to have it delivered to NASA Headquarters during the summer. A fall Workshop will coordinate the Project, and there are plans to develop an on-line research bibliography to be housed at the Lunar and Planetary Institute. (Interested researchers are asked to send reprints and other publications on the Caribbean to: **Mr. Stephen Tellier, Caribbean Plate Project, Lunar and Planetary Institute, 3303 NASA Road One, Houston, TX 77058, U.S.A.** Further information on the Project may be obtained from **Dr. G. Wadge** at the same address.)

Glossary of Geology Adds 3,000 Terms

A major dictionary of the earth sciences — the *Glossary of Geology* — is now available in an expanded, up-to-date edition which includes 36,000 terms (compared to 33,000 in the 1972 edition) and reflects changes in the geoscience vocabulary in the last decade.

Changes in the *Glossary* are particularly evident in fields

such as biostratigraphy, remote sensing, plate tectonics, caves and karst, igneous petrology, paleomagnetism, and seismic stratigraphy. The compilers added about 450 new mineral names, more than 100 abbreviations, such as GOR (Gas Oil Ratio), LVL, and PDB, nearly 500 new references to the literature, as well as useful aids to users.

The new work was edited by Robert L. Bates (widely known for his monthly column in *Geotimes*) and Julia A. Jackson of the American Geological Institute. It is available from: *American Geological Institute, 5205 Leesburg Pike, Falls Church, VA 22041, U.S.A.* (Cost: \$60.00 U.S.).

International Symposium Honours Wegener

On the occasion of the 100th anniversary of the birth of Alfred Wegener — the Copernicus of the geosciences — and in memory of his death in ice-covered Greenland 50 years ago, an International Symposium was held in Berlin, F.R.G. from February 25 - 29, 1980. Organized by German geoscientific societies and organizations, as well as the European Geophysical Society, the Geophysical Society of Switzerland, the American Geophysical Union and some of the IUGS subcommittees, it was attended by more than 2,000 geoscientists from all over the world.

Born in Berlin to a family of theologians, Wegener studied natural sciences in Berlin, Heidelberg and Innsbruck. After receiving his doctoral degree, he worked as meteorologist in an aeronautical laboratory for a short time, and then took part in a Danish expedition to Greenland. He later became Professor of meteorology and geophysics at the Universities of Marburg and Hamburg (Germany) and finally in Graz (Austria). He died during his fourth expedition to Greenland in November of 1930.

His greatest personal interests were in polar research and in "continental drift", a precursor to the plate tectonics theory, formulated by Wegener around 1910. This involved reconstructions using displacements and matching of continents at specific altitudes or depths (as, for example, both sides of the Atlantic at the edge of the continental shelf). Wegener was also one of the first to recognize the importance of an interdisciplinary approach to geoscience: his publications span the fields of astronomy, physics of the atmosphere, meteorology, climatology and paleoclimatology.

Appropriately, the Symposium covered this wide range of subjects and parallel sessions were deliberately avoided to underline the importance of interdisciplinary discussions. Sessions reviewed geoscientific developments since Wegener. Two full days were devoted to problems of plate tectonics and continental drift, while half-day symposia dealt with polar research, paleoclimatology and paleobiogeography.

An Alfred Wegener Foundation — an association for the promotion of common geoscientific interests — was established during the Symposium.

P. Giese
*Symposium Organizing
Committee*

V. Jacobshagen
*Symposium Scientific
Committee*

Stratigraphy Commission Agrees on Logo

The IUGS Commission on Stratigraphy has chosen the Chinese logograph for *shan*, mountain, for its logotype. The design, adapted for printing but retaining the serif-like tips taken over from calligraphic brush-painting, will be used by the Commission's working groups either alone or against a background of four thin lines - symbolizing the three Eons of Earth's history and their boundaries.

According to the Commission's Chairman, **Prof. Anders Martinsson**, the new logotype presented the Commission with an interesting alternative to the more traditional hammer (sometimes crossed with a pick), map, or even punch-card.

GEBCO – Fifth Edition – Close to Completion

A joint committee of marine geologists and geophysicists specializing in morphological charting of the sea-floor and representing both the International Hydrographic Organization (IHO) and the Intergovernmental Oceanographic Commission (IOC) of UNESCO, is guiding the production of the fifth edition of GEBCO - the general bathymetric chart of the oceans. Ten of the final 18 charts covering the world on a scale of 1:10 000 000 are now available, and current plans are to complete the last chart by May, 1982.

The IHO is responsible, in conjunction with the 19 volunteer Hydrographic Offices of its member states, for maintenance of 655 base master sounding sheets on a scale of 1:1 000 000, and for cartographic advice on (and supervision over) the final product.

The IOC, in conjunction with ICSU's SCOR, IUGG's IAPSO and IUGS' CMG, has accepted responsibility for all the scientific input into the project, including the contouring of bathymetric data and compilation of the final waterwork for each sheet. Cartographic production of the sheets is undertaken by the Canadian Hydrographic Service in Ottawa. The basic project, grid and land work is taken from the *Carte générale du monde* by permission of the Institut géographique national in France.

The fifth edition represents a new form of presentation for the series, which traces its origins to the Seventh International Geological Congress in Berlin in 1899. Sheets are available at \$5.00 (Can.) plus handling charges from: *Hydrographic Chart Distribution Office, Dept. of Fisheries and the Environment, 1675 Russell Road, P. O. Box 8080, Ottawa, Canada, K1G 3H6*. For general information on GEBCO and the availability of the charts around the world, write to: *The Secretary, Intergovernmental Oceanographic Commission, UNESCO, Place de Fontenay, 75700 Paris, France*.

ASSEMBLY DIAGRAM FOR GEBCO SHEETS (5th Edition)

News from IUGS National Adhering Bodies

. Netherlands:

The Director of the Royal Netherlands Academy of Arts and Sciences, **J.Th.A. Klarenbeek**, announces the current Council membership of the Academy's Commission for Geological Sciences — Netherlands' national adhering body for IUGS:

Chairman: **Prof. Dr. J.D. de Jong**
Dept. of Geology, Agricultural University, Wageningen

Secretary: **Dr. H.J.W.G. Schalke**
National Museum for Geology and Mineralogy, Leiden

Members: **Prof. Dr. C.W. Drooger**, Dept. of Stratigraphy and Paleontology, Utrecht University;
Dr. B.P. Hageman, Director, Geological Survey of the Netherlands;
Prof. Dr. H.N.A. Priem, Director, Z.W.O. Laboratory of Isotopes — Geology;
Dr. A.R. Ritsema, Earth Science Dept., Royal Netherlands Meteorological Institute;
Prof. Dr. E. den Tex, Dept. of Petrology and Mineralogy, Leiden University.

The postal address for the Royal Netherlands Academy of

Arts and Sciences is P.O. Box 19121, 1000 GC Amsterdam, Netherlands.

. Peru:

Ing. R. Fuentes and **Ing. O. Bernuy** (Vice-President and Secretary respectively of the Geological Society of Peru, the IUGS national adhering body), have informed us that the Council of the Society for 1980-81 will consist of the following:

President: **Dr. J. Arce Helberg**
Vice-President: **Ing. R.F. Fuentes**
Secretary: **Ing. O. Bernuy Verand**
Treasurer: **Dr. C. Hudson Cabeza**
Associate Treasurer: **Ing. M. Narango Alvines**
Librarian: **Sra. V. Alleman de D'Ans**
Members: **Ing. J. Davila Burga; Ing. C. Muñoz Pineda; Dr. G. Kross; Ing. A. Huaman; Ing. J. Zagarra; Ing. J. Saez Paz; Ing. F. Estrada Chavez; Dr. A. Kihien; Ing. J. Paredes Mantilla; Ing. S. Canchaya.**

The Council is responsible for the Society's participation in IUGS activities.