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International Non-governmental Cooperation in the Solid Earth Sciences

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Abstract

Science is the best field of human activities for international cooperation, since its mission is to create and develop new knowledge, which then belongs to mankind; in this sense, it has a universal transnational character. The Earth Sciences, in addition, have a built in strong regional component, because their development requires observations and measurements in all parts of the world, followed by complete communication and exchange of information. The needs for international cooperation are obvious.

There are two main structures for international scientific activities. One of them is governmental, related to the United Nations, where scientific cooperation is mainly dealt with within UNESCO. The other is non-governmental, and related to ICSU, the International Council of Scientific Unions. ICSU comprises 20 scientific unions, dealing with specific fields, three of which belong to the Earth Sciences: IUGG (International Union of Geodesy and Geophysics), established in 1919, IGU (International Geographical Union) formed in 1922, and IUGS (International Union of Geological Sciences) organized in 1961.

The aims of IUGS include the encouragement of research on geological problems of fundamental or applied character, and the promotion of international inter-disciplinary cooperation in geology and related sciences. The scientific activities of the Union are carried out by international committees or commissions (Stratigraphy, Tectonics, etc.) or by affiliated organizations and autonomous international associations or societies such as INQUA, IAEG, AGID, IAGC, SEG, etc.

IUGS, similarly to the other sister Unions, and ICSU itself, does not perform actual research, but allows the scientific community to accomplish activities otherwise impossible (or very difficult) without adequate international organization. It provides only seed money for the necessary coordinating meetings, in which exchange of scientific information, planning of research, and discussion of data and interpretations, are made.

More and more, in recent years, geology has acquired a global perspective because of the unifying model of plate tectonics and because of the new concept of treating the earth as a complete system whose parts are inter-related. Among the successful international programs of global perspective involving the Earth Sciences, are the International Geophysical Year (late 50's), the Upper Mantle Program (60's) and the Geodynamics Projects (70's). The latter two were run in partnership between IUGG and IUGS as inter-union programs. Their successor, the International Lithosphere Program, started in 1981 and is entering a new phase in the 90's which promises great achievements.

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IUGS also promotes research activities together with UNESCO. Its main purpose in this respect is the International Geologic Correlation Program, started in 1972 and still successfully continuing. In addition, IUGS collaborates also in some of the major interdisciplinary programs, such as the ICSU International Geosphere-Biosphere Program (Global Change) and the International Decade for Natural Disaster Reduction, for which there is also a strong UNESCO component.

Since the international organizations provide only scientific coordination, the research is carried out by scientists in their own institutions and thus the participation and support by national organizations is essential. In many countries, the geological surveys are the strongest organizations in geological research, especially in the Third World, where academic institutions are usually not well developed. Reciprocally, the international experience through effective participation in international programs may greatly benefit the geological surveys because of the exchange of personnel and information, which leads to improved interpretations of the regional and global problems.

Résumé

De tous les champs d'activité humaine, la science est celui qui se prête le mieux à la coopération internationale, vu que sa mission consiste à élargir la sphère des connaissances pour le plus grand bien de l'humanité. Dans ce sens, la science possède un caractère transnational universel. De par leur nature, les sciences de la Terre ont, en plus, une importante dimension régionale, étant donné que leur progrès exige des observations et des relevés dans toutes les parties du globe, puis des communications et des échanges de renseignements. Les besoins de coopération internationale sont évidents.

Les activités scientifiques internationales se déroulent au sein de deux grandes structures. L'une est gouvernementale et relève des Nations Unies, où la coopération internationale se fait surtout dans le cadre de l'UNESCO. L'autre est non gouvernementale et relève du Conseil international des unions scientifiques (CIUS). Le CIUS comprend 20 unions scientifiques qui traitent chacune d'un domaine bien précis. Trois d'entre elles concernent les sciences de la Terre: l'Union de géodésie et de géophysique internationale (UGGI), créée en 1919, l'Union géographique internationale (UGI), établie en 1922, et l'Union internationale des sciences géologiques (UISG), fondée en 1961.

L'UISG vise, entre autres, à stimuler la recherche fondamentale ou appliquée pour résoudre des problèmes géologiques et à favoriser la coopération interdisciplinaire internationale en géologie et dans les sciences connexes. Les activités scientifiques de l'UISG sont poursuivies par des comités ou commissions internationaux (de la stratigraphie, de la tectonique, etc.) ou par des organisations affiliées et des associations ou sociétés internationales autonomes comme l'UIEQ, l'AIGI, l'ASDI, l'AIGC, la SEG, etc.

Tout comme les autres unions et le CIUS lui-même, l'UISG ne poursuit pas de recherches, mais permet aux milieux scientifiques d'exécuter des travaux qui s'avéreraient impossibles (ou très difficiles) sans une bonne organisation internationale. Elle se contente de fournir une mise de fonds initiale pour les réunions de coordination nécessaires, où ont lieu les échanges d'informations scientifiques, la planification des recherches et la discussion des données et des interprétations.

Depuis quelques années, la géologie prend des dimensions de plus en plus mondiales. Cela est dû au modèle unificateur de la tectonique des plaques, ainsi qu'au nouveau concept qui consiste à voir dans la Terre un ensemble complet aux parties interdépendantes. Au nombre des programmes internationaux de portée planétaire qui ont donné de bons résultats dans le domaine des sciences de la Terre, citons l'Année géophysique internationale (fin des années 50), l'étude du manteau supérieur (années 60) et le Projet géodynamique (années 70). Ces deux derniers programmes ont été poursuivis conjointement par l'UGGI et l'UISG. Leur successeur, le Programme international d'étude de la lithosphère, lancé en 1981, entame maintenant une nouvelle phase dans les années 90 et promet d'aboutir à de grands résultats.

L'UISG encourage également des activités de recherche, de concert avec l'UNESCO. Son point de mire à cet égard est le Programme international de corrélation géologique, lancé en 1972, qui

continue encore à donner de bons résultats. Par ailleurs, l'UISG collabore à certains grands programmes interdisciplinaires comme le Programme international sur la géosphère et la biosphère (changement planétaire) du CIUS et la Décennie internationale de la prévision des catastrophes naturelles, où l'UNESCO joue aussi un rôle important.

Les organisations internationales ne fournissent que la coordination scientifique; les recherches sont effectuées par des chercheurs dans leur propre institution, et c'est pourquoi la participation et l'appui des organisations nationales sont essentiels. Dans de nombreux pays, les commissions géologiques sont les organismes qui font le plus de recherches géologiques, notamment dans le tiers monde, où l'infrastructure universitaire n'est généralement pas très développée. Réciproquement, l'expérience internationale retirée d'une participation utile à des programmes internationaux peut grandement profiter aux commissions géologiques, car les échanges de personnel et d'informations aboutissent à de meilleures interprétations des problèmes régionaux et mondiaux.

I wish to thank the organizers for this opportunity to participate in the sesquicentennial of the Geological Survey of Canada. I'm especially pleased to talk to so many friends from all over the world here in Canada, because Canada, and especially the Geological Survey of Canada, were always very close to the Union. Jim Harrison was the first president of IUGS and Bill Hutchinson was my predecessor as president. But IUGS was also close to Canada because of the extremely important and fruitful voluntary work of so many people from this Survey, such as Ray Price, Chris Findlay, Jim Monger, Mike Berry and many others. A special tribute also goes to Tony Berger and Vera Lafferty, who developed Episodes, the well known IUGS journal. The Canadians had it for ten years, and we must say it was a great help for the Union.

I'm going to talk about international cooperation in the earth sciences. You know that Science is the best field of human activities for international cooperation, since its mission is to create and develop new knowledge which then belongs to mankind. In this sense it has a universal, trans-national character. The earth sciences, in addition, have a built-in, strong regional component, because their development requires observations and measurements in all parts of the world, and that is followed by complete communication and exchange of information.

Besides spontaneous bilateral or multilateral programs between countries, there are two main structures for international scientific activities. One is governmental, and related to the United Nations, where scientific cooperation is mainly dealt with in the United Nations Educational, Scientific and Cultural Organization (UNESCO). Other agencies deal to some extent with earth sciences, like the United Nations Development Programme (UNDP), the UN Disaster Relief Organization (UNDRO), the United Nations Environmental programme (UNEP).

The other structure is non-governmental and it's related to the International Council of Scientific Unions (ICSU). ICSU comprises 20 scientific unions dealing with specific fields, three of which belong to the earth

sciences. They are the International Union of Geodesy and Geophysics (IUGG), the International Geographical Union (IGU), and the International Union of Geological Sciences (IUGS). Besides that there are other Unions dealing with different disciplines. ICSU itself deals with inter-disciplinary activities, and two examples of the many scientific committees are SCAR for Antarctic Research and COSPAR for space research. There are also some inter-union committees, such as the Inter-Union Commission on the Lithosphere, that carries out the International Lithosphere Program (ILP).

In the ICSU system, administration is done by a general assembly of all 20 Unions, and all national members, which represent 75 countries. There is a general committee that meets annually and then the Executive Board meets two, three or four times a year depending on necessity. The ICSU structure is based on the scientific unions, which deal with single disciplines and are international in character. The national members are national academies or societies or associations within given countries, that is non-governmental bodies dealing with science. Within ICSU there are also scientific associates, common concerns and services, and interdisciplinary scientific activities to which all the scientific committees and the global programs belong; for example, the International Geosphere Biosphere Program (IGBP), which is the largest.

The Council interacts with many different scientific organizations, especially the ones which are intergovernmental. The main one is UNESCO, but there are many others such as the World Meteorological Organization, the International Atomic Energy Agency, and so on. ICSU deals with many of those intergovernmental agencies and joint ventures are made in the field of Science.

The international conference "An Agenda of Science for Environment and Development into the Twenty First Century" (ASCEND 21) was a recent venture by ICSU in order to facilitate the building up of a scientific program for the Rio '92 conference of the United Nations. ASCEND 21 was held in Vienna last December with 250

scientists, engineers, and social scientists from all over the world. It was a really inter-disciplinary effort and a complete book will be published in May (next month) in time for the Rio '92 conference. I'm sure it will be a fantastic book, a look into the future.

The IUGS is one of the ICSU's 20 scientific unions. It began in 1961 as an outcome of the International Geological Congress. The Congresses started last century, and we are going to have the next one in Japan in August/September this year. I am very proud to say that IUGS is one of the more active of the ICSU unions in promoting international cooperation.

The basic objectives of IUGS are to encourage the study of geoscientific problems, facilitate interdisciplinary cooperation in the geosciences, and support and sponsor the international Geological Congress. IUGS has a council made up of member countries of the Union. We have 96, more than ICSU itself. The Council meets every four years at the occasion of the Geological Congresses. The Union has an Executive Committee that meets annually, and a Bureau that meets more frequently. The Bureau will meet here in Ottawa next Wednesday, taking the opportunity of being here to carry out some of the actions of the Union. The Union has a permanent Secretariat, in Trondheim, Norway. It has advisory boards that give advice to the Executive Committee. The scientific structure consists of commissions, committees, joint programs and affiliated organizations.

The commissions operate in many sub-disciplines of the geosciences - stratigraphy, tectonics, petrology, etc. The Commission on Stratigraphy, for instance, is older than IUGS itself and has about 2000 members worldwide. It provides recommendations on a global scale which are essential to make stratigraphic correlations. The other commissions work in the same way. There are also Advisory Boards for publications, for research developments, and for remote sensing applications to geology, which make recommendations to the Executive Committee. In addition, there are affiliated organizations, about 30 independent societies or associations, which carry out their scientific work in each of their field of interest.

Examples are the International Mineralogical Association (IMA), the International Paleontological Association (IPA), the International Quaternary Association (INQUA), the Commission for the Geological Map of the World (CGMW), and the Geological Society of America (GSA). Some of them are much larger than IUGS itself.

IUGS, similar to its other sister unions and ICSU itself, does not perform research but allows the scientific community to accomplish activities otherwise impossible or very difficult without adequate international organization. It provides only seed money for the necessary coordinating meetings in which exchange of

scientific information, planning of research, and discussion of data and interpretations are made.

You have seen some figures from the large geological surveys all over the world, whose budgets are on the order of 100 or more million dollars for their annual operation. For ICSU, the largest part of its income, 43%, amounting to about 1.5 million dollars, comes from membership contributions. The total income of ICSU is a little more than 3 million dollars.

The largest scientific unions, IUPAC, IUBS and IUGS, all had less than 1 million dollars each. The annual budget of IUGS is of the order of \$600,000. The budget for the big International Geosphere/Biosphere Program (IGBP), in 1990, was not more than 1.3 million dollars. Sources are the National Academies, some international societies, and some other external sources like UNESCO. In short, the cost of the entire non-governmental system for science is approximately \$10 million, which is much less than an annual operation of any one of the large surveys. However, the benefit/cost of those activities is extremely high, because the extremely small seed money given to any coordinating activity (for instance an IGCP project) produces additional research funds with multiplication factors exceeding 1000.

IUGS is a new scientific union. Before it, only IGU and IUGG dealt with international cooperation in the earth sciences. At the beginning of this century, they dealt mainly with acquisition of regional data, exploration of unknown territories, expeditions and so on. In the last three or four decades there has been an evolution into modelling and interpretation of data. I think the main achievement of the geological sciences is the emergence, in the late 1960's, of the unifying concept of plate tectonics which explains the observed dynamics of our planet. Plate tectonics is regarded as an outcome of the Upper Mantle Project, which was started by IUGG in the early 1960's to look at the upper mantle, and its influence on the development of the earth's crust. The recently formed IUGS (IUGS was formed in 1961) was invited by IUGG to be co-partner in that activity, through Jim Harrison, at that time President of IUGS. In its turn, the Upper Mantle Project was also a direct outgrowth of the International Geophysical Year, and that was a venture in '57/'58, planned by ICSU. IUGG had a big part in the IGY in order to solve some specific planetary problems of the Earth, through observations in remote and relatively inaccessible regions such as the Arctic or the Antarctic. And from that endeavor, many of the ICSU's scientific committees had their origins, such as SCOR (oceanographic research) and COSPAR (space research), as well as the already mentioned Upper Mantle Project.

The Upper Mantle Project had a successful successor program in the 1970's, the Geodynamics Project (IGP). It was again a partnership between IUGG and IUGS. It looked at the solid earth as a dynamic system, and made

numerous tests for the plate tectonics theory, especially within the oceans. An extraordinary amount of high quality data was produced by the IGP, mainly confirming the predictions of the plate tectonic theory.

The Geodynamics Project was followed by the International Lithosphere Project (ILP), whose main emphasis is to understand the origin and evolution of continents. It's more applied in character and it looks also at geological hazards, natural disasters, natural resources and environmental protection. All these international cooperative research programs, the largest ones in the earth sciences, are originated mainly within the ICSU family, especially by IUGG and IUGS.

IUGS also has partners outside the ICSU family, and the best example is the International Geological Correlation Program, whose co-sponsor is UNESCO. I will not speak on IGCP, because Dr. Naldrett will do so in detail. Other programmes with UNESCO are the Deposit Modelling Program (DMP), and GARS. The DMP deals with workshops and field work on selected ore deposits mainly in developing countries. Interaction of local geologists with first class economic geologists is very fruitful. GARS (Geological Application of Remote Sensing) is directed towards technology transfer, namely Remote Sensing technology transfer to developing countries. As an example, I shall mention last year's effort in Columbia to identify landslide-prone areas in the Andes through the examination of satellite imagery.

The Circum-Atlantic Project is a large program to develop maps, data banks and so on in the region of the Atlantic and the countries around it. IDNDR, the International Decade of Natural Disasters Reduction, is a world-wide operation, and many of the unions of ICSU are part of it. It was started by a resolution of the U.N. General Assembly, declaring the 90's as a decade for natural disaster reduction. The major effort will be by governments, in order to make prediction and prevention of disasters rather than relief and reparation. Then we have the IGBP, the International Geosphere-Biosphere Program, which is the main program of ICSU, and IUGS, as well as many other sister unions, is participating in this. It must be stressed here that global change activities within ICSU include IGBP as one program, as part of the main research system. WCRP (World Climate Research Program), SCOPE (Scientific Committee Related to Environment) and many scientific unions and scientific committees also participate with their own programs on global change. However very big, IGBP is only one program on global change.

Since the international organizations provide only scientific coordination, research is carried out by scientists in their own institutions, and thus participation and support by national organizations are essential. In many countries the geological surveys are the strongest organizations in the earth sciences, and that is so especially in the Third World, where the academic institutions are usually not very well developed. Hence, the geological surveys play a major role in international cooperation. The input from geological surveys into IUGS activities has always been very strong. We have a permanent Secretariat which is located at the Geological Survey of Norway. The Chairman of our Advisory Board for Research Development is Royce Rutland, from the Bureau of Mineral Resources of Australia. Among the officers of the Executive Committee of the Union, we have Robin Brett from the USGS, Michael Schmidt-Thomé, from the German BGR, Mohammed Bensaid, from the Moroccan Survey, and Godfried Kesse, from the Geological Survey of Ghana.

IUGS also has many members from geological surveys in programs such as Deposit Modelling, the first chairman of which was Chris Findlay. A special subcommission of IUGS is on global data management and information systems, and has representation of the major geological surveys throughout the world. The aim of it is to standardize and exchange geological and geophysical data.

I wish to stress the symbiotic relationship between the Union and the surveys. Necessarily, there is a great involvement of the geological surveys with IUGS, and IUGS will have insuperable difficulties without support from the surveys. Reciprocally the surveys also benefit from the interaction and the effective participation in international programs, because of the exchange of personnel and exchange of information. Their geologists in this way receive relevant expertise, to be applied later in the interpretation of the regional data and global programs.

I hope that these few examples I have given to you are sufficient to stress the importance of international cooperation for scientific development in geology. Moreover, they show the symbiotic character of the participation of governmental and non-governmental scientific bodies. Everybody gains if these activities are carried out properly, for the development of science and benefit of society.