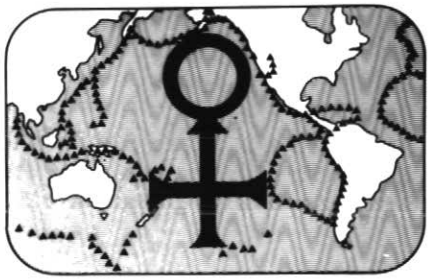

Two Meetings – Two Ways

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In the latter part of 1974 I attended two meetings on mineral resources that offered strong contrasts in style. These were the Circum-Pacific Energy and Mineral Resources Conference in Honolulu on August 26 to 30 and a seminar on Copper Resources in Porphyry Deposits in Menlo Park on December 9 to 11. Neither meeting resembled typical Geological Society of America or Geological Assocation of Canada Annual Meetings to any significant degree, partly because of the congruence of interest of all participants and partly because both meetings relied entirely on invited speakers. Apart from these facts and the related subjects, the meetings were totally different.

Circum-Pacific Energy and Mineral Resources Conferences

The Honolulu meeting treated all the energy and mineral resources but attendance was dominated by petroleum geologists. The meeting was sponsored by the American Association of Petroleum Geologists, the Pacific Science Association, and the Committee for Coordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas but was chiefly organized by the AAPG. Some 817 delegates accompanied by 423 spouses attended from 29 countries, chiefly of the Pacific Rim. The composition of speakers and delegates was interesting. A pattern common at other international meetings was particularly evident here, i.e., age stratification of speakers from the different "Worlds." Participants from the U.S.S.R. were very senior geoscientists, those from the Western World and Japan were mature and generally of established reputation, whereas those from the Third World were generally young although not necessarily inexperienced. In fields other than petroleum, delegates were chiefly government or university staff. The scant attendance of Vancouver-based exploration personnel was curious in view of the current extra-provincial focus of their activities and the dominance of porphyry copper and metallogeny in the mineral resource sessions.

The five-day meeting started with two days of general papers on resources, geology, and economics. Dr. Harlan Cleveland, then President of the University of Hawaii, gave a keynote address at luncheon on the first day that developed a humanistic and moral approach to resources and their utilization. His approach was largely absent from the technical talks which rightly or wrongly assumed the basic logic that more resources must be discovered and developed for the future. John Winger developed the theme that the supply of energy or mineral resources is directly related to investment in search and development but that lag time between investment and resource use is increasing. J. Moody *et al.* presented a Pacific-wide view of the geology based on bathymetry, fracture patterns, and volcanic trends. They concluded that although the data for such a region is scant, the Pacific consists of four independent crustal fragments; that patterns are similar to those of the continents; and that the major shear fault pattern transcends the nature of the crust, whether oceanic or continental. P. A. Rona and L. P. Newman gave an ocean-wide view of plate tectonic and mineral resources - a model most geologists are now thoroughly familiar with, but they did integrate the distribution of site of origin of petroleum, coal, iron and ferro alloy metals, base metals, and other resources with gravity, heat flow, and sediment thickness. They also tried to relate the rate of movement of the underthrust plate to angle of the Benioff zone (-55° for slowest spreading to 12° for fastest, ca. 12 cm/year) and to the distribution of metal. W. M. Zarella's paper on environmental constraints dwelt mainly on oil problems and his approach was to study natural pollution (oil seeps, etc.) and the long-term effects on flora and fauna. He said these demonstrated that in most environments contamination by petroleum rarely had long-term effects. Fischer *et al.* dealt with the utility of ERTS photos and stretched the truth, at least in regard to the Canadian Cordillera. The Circum-Pacific map project was outlined by J. A. Reinemund. New maps in five sets (bathymetry, geology, tectonics, mineral deposits, and energy) at a scale of 1:10 million are to be published in four overlapping quadrants and one compilation group at a less detailed scale.

On the last three days separate sessions were devoted to geothermal, hydrocarbon, and mineral resources. I attended the latter sessions. In these coverage was geographically complete and fairly balanced. Two of the most interesting papers among those on regional metallogeny were those of C. Nishiwaki *et al.* on Japan and G. E. Ericksen on the Andes. Ericksen described a pattern similar to that of the Canadian Cordillera but simpler with a trend from iron-rich skarns on the coast to copper porphyries, polymetallic (lead, zinc, copper, and silver) and tin and tungsten successively further east. Pre-Jurassic deposits are insignificant, most are mid-Jurassic to Tertiary and related to calc-alkaline plutonism. In contrast to the Canadian Cordillera, the porphyry copper deposits of Chile and Peru generally consist of protore of approximately one per cent copper, except for Toquepala (0.7 per cent), but grade decreases eastward so that in Argentina 0.2 to 0.6 per cent copper is characteristic. He also pointed out the regional correlation between thickness of crust (greater than 70 km) and highest mineral potential. Nishiwaki *et al.* demonstrated that in Japan the Kuroko polymetallic deposits are clustered about offsets on the combined seismic and gravity zones. These offsets are probably major faults transverse to structure which have little or no expression in the surface geology.

In contrast to the foregoing the regional metallogenic papers on Alaska and Mexico seemed like preliminary syntheses. R. Jahn's talk on the metallogeny of the Cordilleran United States reinforced my opinion that its

complexity precludes its use as any sort of model.

Three separate papers were given on the Canadian Cordillera by H. Gabrielse, V. E. Hollister, and the writer. Gabrielse discussed the environments of depositional basins and settings of mineral deposits succinctly but tended to ignore the Insular and Coast Crystalline Tectonic Belts. Hollister took a slightly divergent view in hypothesizing rift origin for the Quesnel trough of the Intermontane Belt and for its copper-rich alkaline volcanic rocks. The writer reviewed the regional zoning of metal background in rocks and the relation to zoning of mineral deposits.

A final session on manganese nodule was very instructive. Lonie and McIntosh described the offshore operation in the Gulf of Carpentaria of one of the highest grade manganese deposits in the world. Unlike deep sea nodules these contain only traces of copper, nickel, and cobalt. Current production is 1.25 million tons of manganese per year. Horn *et al.* gave an excellent paper describing the two-stage origin of the deep sea nodules and also of the origin of the belt of high grade nodules that stretches 2,500 miles east from 800 miles south of Hawaii.

Symposium on Appraisal of Copper Resources in Porphyry Deposits

The symposium on porphyry copper deposits held at Menlo Park was very different in nature although on a topic that was central to much of the mineral resource sessions at Honolulu. The symposium was an in-house meeting of the United States Geological Survey, organized by W. P. Pratt and D. P. Cox, to which about 30 geoscientists were invited including R. V. Kirkham and A. E. Soregaroli of the Geological Survey of Canada and myself. Most participants also contributed talks for discussion. Speakers largely confined themselves to a 15-minute presentation and discussion following was not truncated and generally equalled the presentation. Although this would seem a relaxed type of meeting, it was in fact very intensive with probing and vigorous discussion.

The three days of discussion were organized under the following headings: Evaluation of Porphyry Resources; Tectonic Environments; Varieties of Porphyry Deposits; Exploration Guides; and Secondary Deposits. Even though the talks were informal and brief, the general level of presentation was good and interest and attention remained high. The following review is selective.

The importance of porphyry deposits in relation to the total copper resource was emphasized by Cod and Kirkham, and by G. E. Ericksen. All three emphasized that porphyry deposits represent 60 to 75 per cent of total copper resource and more of course for molybdenum. Estimates for total known economic and near-economic copper resources were as follows:-

U.S.A.
130 million tons of contained copper
Canada
31 million tons of contained copper
Andean South America
100 million tons of contained copper.

Kirkham's estimate for Canada seems conservative as British Columbia's reserves are over 20 million tons.

The importance of the super-giant deposits was emphasized by pointing out that the four largest deposits in the United States contain well over half the reserves, and Braden and Chuquicamata contain 70 per cent of those of South America. Likewise the Highland Valley deposits contain 40 per cent of British Columbia's reserves.

P. M. Blacet's talk on copper potential maps and Maureen Johnson's that followed, concerned maps similar to British Columbia Department of Mines and Petroleum Resources Mineral Deposit-Land Use maps but with differences in approach and effort needed to compile them. The USGS copper potential maps are based on a five-fold simplified geological base (i.e., sedimentary and volcanic rocks older than copper-bearing porphyries, etc.) on which is superimposed a three-fold mineral potential depending on distribution of showings and properties and porphyry bodies of "right" age. One-thousand-foot contours of valley fill were also shown. Since these maps were produced, the State of Arizona has frozen all land development in the "A" category and above the 1,000-foot contour of valley fill, much to the chagrin of the group at Menlo Park who think of the maps as we do, as preliminary. To produce two two-degree sheets occupied six experienced geologists one year including field work. In contrast, in British Columbia 44 maps at a scale of 1:250,000 have been produced by two geologists in a little over two years because of the systematic geological map coverage by the GSC and the advanced state of mineral inventory in British Columbia.

The session on varieties of porphyry deposits was dominated by the Canadian participants (Kirkham, Soregaroli and the writer). In addition Cox described the quartz-diorite porphyry deposits of Puerto Rico and R. G. Schmidt described Quaternary volcanoes and porphyries in western Pakistan. The impact of these talks was certainly that true porphyry deposits have something close to Cleopatra's infinite variety.

Five talks dealt in various ways with the physical chemistry of porphyry systems and the visible petrographic results. Paul Barton's dealt with the circulating mainly external hot water cell and developed "simple" P.T. and other diagrams with great rapidity. He did emphasize however the efficacy of second boiling in the process and the possibility of epithermal deposition of zinc from the same system deposited near the surface. R. O. Fournier showed how the variation between lithostatic and hydrostatic pressures could bring about tremendous changes in salinity and hence metal carrying capacity of the fluids. C. G. Cunningham showed by study of fluid inclusions that the Italian Mountain Porphyry in the Colorado Mineral Belt was emplaced at between 950 to 2,700 metres (250 bars) and at 435° centigrade, and that the intrusion vented to the surface. J. T. Nash's talk on general aspects of the same subject was most interesting and presents a highly useful way of evaluating the potential of a porphyry to contain ore deposits, especially in weathered zones. Porphyry deposits are unique in their high saline content (ca 25 per cent by weight versus less than 10 per cent in other deposits). Inclusions showing liquid, halite, or sylvite crystals and vapour represent unique P.T. and composition conditions that are present in most ore-bearing porphyry deposits of phyllic type. Other generalizations include: early fluids are not as saline as later ones; lower grade deposits appear to have lower salinities; and alteration shells can also be related to salinities of inclusions. W. J. Moore showed that at Bingham Canyon only the ore-bearing pluton in its mineralized portion contains the "potent" fluid inclusions. The technique of examining fluid inclusions can be used to evaluate exposed, leached, or saprolitic weathered

porphyry deposits for potential. Apparently neither the very high salinities nor vapour is evident in specimen from Highland Valley so that plutonic porphyries are in fact probably formed at deeper levels (i.e., base of epizonal to mesozonal). Presumably volcanic porphyry deposits also contain potent fluid inclusions. The syenitic porphyries will be more difficult to examine because of the lack of quartz.

Clearly these two meetings were very different in size, ratio of speakers to listeners, flux of discussion, cost of attending, etc. The large meeting was by most standards very successful. Nevertheless small informal meetings gain currency as large meetings become increasingly ponderous in planning, costly of attendance, and unsatisfactory in mutual exchange of information.

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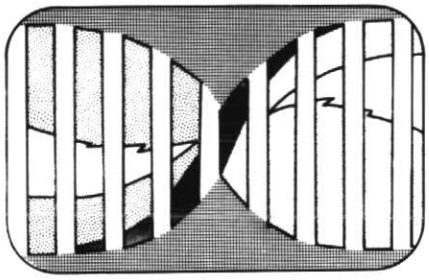

IGCP Project: Precambrian in Mobile Zones - Meetings in 1974

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Summary

During 1973 an International Union of Geological Sciences (IUGS) correlation project dealing with the Precambrian of mobile zones east and west of the North Atlantic began to operate; excursions were conducted in Morocco (1973) and northwestern France (1974), and a meeting was held in Paris in January 1974 to discuss problems associated with correlating the areas of Precambrian included. In April 1974, it became a key project of the International Geological Correlation Programme (IGCP), and the Board of IGCP suggested that it take in a similar project (Precambrian Stratigraphy) proposed by the Geological Survey of India. At a constitutional meeting in Paris, November 1974, the organization of the modified project and the rules governing it (statutes) were set up, and a limited programme of future activities agreed upon pending the holding of the first plenary session in Moscow in September 1975. This paper is a brief report of the two Paris meetings and of the scope of the project at the present time.

Introduction

Late in 1972, a correlation project, proposed by Dr. G. Choubert and Dr. (Ms.) A. Faure-Muret under the title *Prêcambrien des Zones Mobiles, Partie II*, was approved by the Coordinating Panel of the IUGS under the code number PA 71.48. This project was to deal, principally, with the correlation of Precambrian rocks to the east and west of the North Atlantic, thus providing a westward extension to the range of Dr. V. Zoubek's project *Précambrien des Zones Mobiles, Partie I* (Eurasia) which had been approved earlier (PA 70.11).

By early 1973, 26 persons from 10 countries (including six from Canada and three from the U.S.A.) had agreed to participate. This response made it possible for the project to get underway - excursions were organized - and arrangements made for a meeting in Paris in January 1974. The first excursion took place in May 1973 (see report by Church and Young, 1974) enabling the participants to study the rocks and their interrelationships in four of the several Precambrian inliers of the Anti-Atlas in Morocco. The Paris meeting (described more fully below) was concerned with a review of the Precambrian of the countries included in the project, possible correlations between them, and a consideration of the most useful criteria for correlation work. In March 1974, an excursion to the Armorican region in northwestern France was carried out.

During 1973, as a result of the setting up of the IGCP as a joint scientific venture by UNESCO and the IUGS, projects previously accepted by the IUGS Correlation Panel had to be resubmitted and receive the approval of IGCP Scientific Committees before they could be considered for possible acceptance by the IGCP Board, the body responsible for the supervision and implementation of the programme. The correlation project *Précambrien des Zones Mobiles, Partie II* was resubmitted in October 1973, and, after evaluation, it was approved by the IGCP Board in April 1974 (under No. 73/1/2) and rated as a key project, i.e., a well-developed international project of major importance. The Board suggested that it take in a similar project (Precambrian Stratigraphy) submitted by the Geological Survey of India. The continuation of the original project (although enlarged in scope regionally), which became uncertain when it had to be resubmitted to the IGCP Board, was thus assured. The title of the project, however, no longer includes the designation *Partie II*, because *Partie I*, which was also resubmitted to the IGCP Board and approved as a key project