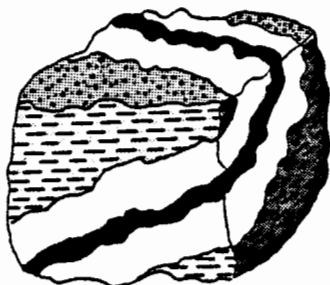


# THE GANGUE

## Mineral Deposits Division Geological Association of Canada No. 21 May 1985



Participants in MDD field trip to Mexican replacement deposits take a Carta Blanca break in Charcas, San Luis Potosi. From left: Cam Scott, tour leader Dave Coolbaugh; Norm Stacey, Don Makela and MDD Chairman-Elect Lee Barker (see report inside).

### EDITORIAL

In this twenty-first issue of the *The Gangue*, the last under my editorial guidance, this exception to a long personal policy of 'no editorials' appeared to be appropriate. First I would like to thank the economic geologists in the GAC who responded so enthusiastically to Hugh Morris' call to form a Mineral Deposits Division back at Toronto '78. Their ongoing support of MDD activities and publications has been sincerely appreciated by all of us who worked to establish and operate the Division.

Secondly I want to thank all the members of the MDD executive with whom I have worked since 1978 as editor, particularly past Chairmen Hugh Morris, Steve Scott, Vic Hollister, Alan Coope, John McDonald and Bob Hewton. The success enjoyed by the Division (and its newsletter!) is due largely to the voluntary labours of these Chairmen and their Executive Committees.

Finally, I extend congratulations to the new editor of *The Gangue*, Giles 'Pogo' Peatfield. It is indeed a pleasure to turn over the editorial reins to someone so capable, talented and committed to MDD goals. I am sure the readers will continue to support Giles with a steady flow of material. Keep those cards and letters coming! The editor's address is: MineQuest Exploration Associates Ltd., 201 - 311 Water Street, Vancouver, B.C. V6B 1B8, Tel. (604) 669-2251.

The MDD is considering embarking upon a major publication venture, the details of which will be presented to the membership at the Fredrickton '85 MDD Annual Meeting. The proposed publication could well be the vehicle that fulfills the Division's founding objective of expanding the avenues of publication for Canadian-authored mineral deposit manuscripts. More news of the project will be

forthcoming in future issues of *The Gangue*. I urge all MDD members to give the proposed publication their fullest support.

K.M. Dawson

### CHAIRMAN'S MESSAGE

A number of events have happened over the last year and MDD has been very active. The following show some of the events in detail. MDD is your group and strives to present activities that are of interest to members. Most of all people are required to provide comment on what is of interest. If there is something that you would like to see done, whether it is a meeting, publication or field trip, please make your ideas known.

### Symposia

MDD is sponsoring or co-sponsoring three upcoming symposia; Sediment-Hosted Stratiform Copper Deposits, Gold 86 and CAME 86 - Byting the Rocks.

The Copper Deposits symposium will be held in conjunction with the GAC meeting in Ottawa in May 1986. It will be held separately starting 2 days before the meeting. Speakers from all over the world, including Poland, Germany, Australia and China as well as from North America will present papers. Field trips to locales in North America and Europe are planned.

Gold 86, to be held in Toronto Sept. 29 - Oct. 1, 1986 will be an international symposium on the geology of gold deposits. Eric Craigie of BP-Selco at 55 University Ave., Suite 1700, Toronto, Ontario, M5J 2H7 is Chairman of the Organizing Committee and can be contacted for further information. The symposium will include descriptions of deposits, recent research, a core shack and field trips. Those wishing to submit papers should contact Eric.

CAME 86 is an update of the computer workshop held in Toronto in 1984. The purpose is to familiarize the mineral exploration community with the various computer services and facilities that are available to them. A full spectrum of applications will be covered in a major exhibition of displays and hands-on demonstrations, and in a series of talks. The conference is intended for the geologist, geochemist and geophysicist in exploration rather than for computer experts. Emphasis will be on practical examples of how computers can be used in exploration.

First Circulars for the Toronto meetings are included in this issue of *The Gangue*.

### Field Trips

Field trips have proven to be very successful for the MDD. The trips to California and to Mexico were both successful and have been described in detail in The Gangee. The trip to Japan is fully subscribed and hopefully will also be a success. There should be a description of the Japanese trip in the next issue of The Gangee.

Plans are being made for trips to:

SPAIN/PORTUGAL in April of 1986

BRAZIL in November of 1986

If you are interested in these trips keep a close watch on The Gangee for details and contacts. It is difficult to plan trips without knowing how many people are interested so please sign on early. This also ensures a seat as virtually all of our trips have been fully subscribed.

We are also always looking for new trips so if any individual has an idea for a trip just contact an MDD representative.

### GAC Meetings

MDD also participates at GAC annual meetings and will be sponsoring a Special Session on Gold in Turbidites at the meeting in Fredericton May 1985. No Special Sessions are currently planned for the other GAC meetings so ideas are welcome.

### Short Courses

Only one Short Course has been planned, structural geology for exploration geologists. A description was printed in Geolog and is elsewhere in this issue of The Gangee. The course is being designed to be of use to the practical field geologist with limited structural geology education or experience but individuals of all levels would find the course rewarding. Do not shy away if you have not had structural geology, this is the course that will familiarize you. Because of advance publication of the course notes we must know the number of people who will be taking the course. Please read the announcement and get in touch with course organizer Dr. D. Shaw (address on announcement) immediately.

### Publications

MDD has been successful in completing the first Guidebook and Reference Manual which is now at the printers and will be available in late April. An announcement describing the text and an order form are included in this issue.

We intend to complete others and people are currently working on the Bathurst camp, the Yellowknife camp and Newfoundland.

Best wishes for a safe and successful field season.

R.S. Hewton

### PROFESSIONAL GEOLOGISTS ACCREDITATION

As many of you already know it has become extremely difficult for geologists, geochemists and geophysicists to become members of professional associations, particularly one of the professional engineers associations. Individual provinces monitor their own association by Acts of Legislature. Alberta has successfully managed to create a category for professional geologists but attempts to do so in other provinces have been treated with disdain by the provincial governments.

Professional standing is required by Securities Commissions and was formerly required by provincial governments for assessment purposes. With the difficulty in becoming registered it is becoming more and more difficult for consulting geologists,

particularly younger ones, to obtain work that must be reviewed by Securities Commissions or governments. In addition, agencies are now accepting reports from geologists without official standing.

A number of solutions to the problem have been suggested including national accreditation for geologists. GAC is currently a national body with widespread recognition and reports by Fellows of GAC are currently being accepted by the Vancouver Securities Commission.

GAC has formed a committee, the Professional Affairs Committee with Bob Hewton as Chairman. The purpose of this committee is to consider the needs of GAC members and determine the need for national accreditation. Should this occur? Should it be within the mandate of GAC or MDD? Should the role of GAC be simply to lobby governments to encourage creation of provincially monitored professional geologists?

Your thoughts on this matter are important and should be sent to R.S. Hewton at:

704 - 602 West Hastings St.  
Vancouver, B.C. V6B 1P2

Information will be collected, viewpoints will be sought and discussed and recommendations will be submitted to Council of GAC.

R.S. Hewton

### PUBLICATIONS

#### New MDD Publication - Highland Valley Guidebook!!

REFERENCE BOOK AND FIELDTRIP GUIDEBOOK TO PORPHYRY COPPER-MOLYBDENUM DEPOSITS OF THE HIGHLAND VALLEY, BRITISH COLUMBIA

W.J. McMillan, British Columbia Ministry of Energy, Mines and Petroleum Resources, Victoria, B.C.

The Highland Valley district, known for its large low-grade open pit porphyry copper-molybdenite mines, is situated in south-central British Columbia about 350 km northeast of Vancouver.

Five major deposits constitute the heart of the Highland Valley district. These are Lornex, Highmont, and Valley Copper, which are operating mines; Bethlehem Copper, which closed in 1982 due to metal prices; and the J.A. deposit which is a potential producer. Two other deposits, Krain and South Seas, which have similar grades but smaller tonnage potential, have also been tested extensively. Numerous small, high-grade vein deposits first attracted attention to the district, and several, OK (Alwin), Snowstorm and Aberdeen, are former small-scale producers.

Aggregate ore reserves for the 13-square kilometre central part of the Highland Valley district are nearly 2 billion tonnes of 0.45% copper equivalent. This figure includes former production and proven reserves, as well as geologically inferred reserves.

This new publications by the Mineral Deposits Division, GAC includes a description of the geology and geochemistry of the Guichon Creek Batholith as well as geology, structure, alteration, mineralization and genesis of the mineral deposits in general and Bethlehem, Highmont, Lornex, J.A., and Valley Copper in detail. Road logs locate key features and a geological map of the Guichon Creek Batholith at a scale of 1:100,000.

The format is a soft cover 8.5 x 11.5 inch book with metal spiral binding to allow easier use in the field or in the office. The volume is now available for purchase, either by mail from:

Mineral Deposits Division, GAC  
704 - 602 West Hastings Street  
Vancouver, B.C. V6B 1P2

or over the counter from the publications desk at the:

Geological Survey of Canada  
6th Floor, 100 West Pender Street  
Vancouver, B.C. V6B 1R8

The cost, in Canadian Funds, is \$16.00. If ordering by mail, please send name, address and cheque payable to "Mineral Deposits Division, GAC" to the above address, and include postage - \$2.00 for parcel post, \$3.00 for first class mail. Inclusion of a self-addressed mailing label with orders will reduce waiting time for receipt of books.

THIS REFERENCE BOOK IS A MUST FOR ANYONE INTERESTED IN CURRENT THINKING ON PORPHYRY DEPOSITS IN WESTERN NORTH AMERICA.

#### Publications Policy

As members of the MDD are no doubt aware, the whole subject of publication of ore deposit-related papers in Canada is one which is receiving considerable attention at present. By the time you read this, the Geology Division of the CIM will have discussed at its annual business meeting the possibility of launching a new quarterly publication for exploration geology papers submitted to CIM. At this time MDD involvement is visualized as participation on the editorial board. We will keep our membership informed as time goes on.

Other avenues for publication by MDD members are under review, and we would appreciate any thoughts which our members might have. An informal committee including Pat Sheahan, Lee Barker and Giles Peatfield are collecting ideas and trying to stimulate discussion in hopes of solving this perennial problem. PLEASE forward any thoughts you might have to any of the above (addresses elsewhere in this Gangeue). Ye new editor welcomes letters from all and sundry on this and other topics for publication in future issues of The Gangeue.

G.R. Peatfield

#### MDD EXECUTIVE NOMINATIONS

The Nominations Committee, A.C. Colvine, Chairman, is please to announce the following list of candidates nominated for positions on the Executive Committee and Board of Directors of the MDD. The positions will be filled at the Annual General Meeting of the Mineral Deposits Division, following the MDD Luncheon at Fredericton '85, in McConnell Hall, UNS, Friday, May 17th.

#### Executive Committee

Chairman	A. Lee Barker Lacana Mining Corporation P.O. Box 354, Royal Trust Tower Toronto Dominion Centre Toronto, Ontario M5K 1K7 (416) 367-0840
Past Chairman	Robert S. Hewton Brinco Mining Ltd. 704 - 602 West Hastings Street Vancouver, B.C. V6B 1P2 (604) 687-2557
Vice Chairman	Christopher M.H. Jennings B.P. Exploration Canada Selco Division 55 University Avenue, Suite 1700 Toronto, Ontario M5J 2H7 (416) 361-0794

Secretary:	R. Barry Cook Cominco Ltd. 120 Adelaide St. West, Suite 1700 Toronto, Ontario M5H 1T1 (416) 869-1850
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Treasurer	Alastair J. Sinclair Department of Geological Sciences University of British Columbia Vancouver, B.C. V6T 2B4 (604) 228-3763
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Program Chairman	James M. Franklin Geological Survey of Canada 601 Booth Street Ottawa, Ontario K1A 0E8 (613) 995-4137
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Publications Chairman	Patricia A. Sheahan Konsult International Inc. 44 Gemini Road Willowdale Ontario M1K 2G6 (416) 223-7750
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Editor, The Gangeue	Giles R. Peatfield MineQuest Exploration Associates Ltd. 201 - 311 Water Street Vancouver, B.C. V6B 1B8 (604) 669-2251
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#### Directors

1985-88	John M. Morganti Placer Development Ltd. P.O. Box 49330, Bentall Four 1055 Dunsmuir Street Vancouver, B.C. V7X 1P1 (604) 682-7082
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Reg A. Olsen Trigg, Woollett and Olson 10504 - 103 Street Edmonton, Alberta T5H 2V4 (403) 425-8905
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Edwin Gaucher E. Gaucher & Associates 2406 Quatre Bourgeois St. Foy, Quebec G1Z 1W5 (418) 659-3512
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1984-87	Ronald H. McMillan, Toronto Richard L. Moore, Toronto Trygve Høy, Victoria
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1983-86	John R. Fraser, Winnipeg A.C. Colvine, Toronto E. Scott Swinden, St. John's
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#### ROBINSON GUEST LECTURER

The MDD has selected Dr. J.G. Thurlow of Buchans, Newfoundland as the first Robinson Guest Lecturer and this choice has been endorsed by the Robinson Committee. Dr. Thurlow will now be available to lecture to the geological community. His talk will be on the geology and mineralization of the Buchans deposits.

Members of MDD who would like to have Dr. Thurlow speak to them are requested to contact either:

Mr. R.S. Hewton Brinco Mining Ltd. 704 - 602 W. Hastings St. Vancouver, B.C. V6B 1P2 (604) 687-2557	Mr. A. Lee Barker Lacana Mining Corp. 1702 150 King St. W. Toronto, Ont. M5H 1J9 (416) 591-6640
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Travelling funds to and from centres will be covered by the Robinson Fund, local costs will be handled by the host group. Arrangements will be made to allow a logical routing for Dr. Thurlow.

More details will be made available as soon as scheduling is prepared.

## UPCOMING MEETINGS

### Fredericton '85

**Symposium** - MDD is co-sponsoring a symposium, organized by Duncan Keppie and Simon Haynes, on turbidite-hosted gold deposits. This symposium is international in scope, and has an impressive lineup of speakers. It promises to be a very worthwhile session.

**MDD Luncheon** - On Friday, May 17th, in McConnell Hall, UNB, will be followed by the annual general meeting of the MDD. This will include the Chairman's review, reports by the Secretary and Treasurer, and, introduction of the incoming Chairman and Executive.

**G.A.C. Luncheon** - On Wednesday, May 15 in McConnell Hall at 12:00-2:00 P.M. This luncheon will be followed by the usual round of speeches and presentations of the various medals of the Association. The highlight from the MDD point of view will be presentation of the Duncan Derry Medal.

### Ottawa '86

**Symposium** - Plans are well underway for a major symposium to review up-to-date knowledge of sediment-hosted copper deposits, to be held in conjunction with the annual GAC meeting in Ottawa. This meeting, international in scope, will include speakers from Poland, Germany, Australia and elsewhere. Field trips are being planned to Spar Lake (Montana), Michigan, and we hope to Poland and Germany. Co-Chairmen of the symposium will be Al Coope (Newmont in Toronto) and Tony Naldrett at the University of Toronto. More details will be provided when available.

**Hemlo Special Session** - Contrary to previously published announcements, the MDD will not be acting as a sponsor of the Hemlo Special Session at Ottawa '86. However, we urge our members to attend if at all possible, as this promises to be a fine session.

**General** - Jim Franklin will be looking after our interests as MDD Program Chairman at Ottawa '86, so if you have any questions contact Jim at the GSC in Ottawa.

## SHORT COURSES

### Structural Field Course

The MDD is proposing to offer an eight day field-course in the fall of 1985 entitled "The Application of Structural Geology Mapping Techniques to Mineral Exploration". The course is directed towards mineral exploration and mining geologists and will combine field and classroom sessions, with the emphasis on the former. A knowledge of structural geology is not required to benefit from the course.

The initial two days of the course will be spent in the classroom where a review of basic structural mapping concepts and their practical application will be given. Possible topics include:

1. Review of three dimensional geometric elements.
2. Structural drill data interpretation.
3. Observation and preliminary analysis of fracture data.
4. Fault geometry, stress and vein patterns.
5. Quantitative construction of cross-sections; sub-surface (level) maps; structure contour maps; projection of surface, drill and geophysical data onto cross-sections and sub-surface maps.
6. Geometry of polyphase deformation. Recognition, documentation and analysis.

Further instruction will then take place in the field. Course participants will form groups of two or three and will map a specific area. An instructor:participant ratio of 1:4 or 1:5 is planned. Results of mapping will be reviewed within the guidelines of the course.

The final part of the course will consist of a day spent reviewing case histories relevant to the theme of the course.

Those instructing will be:

Dr. Richard L. Brown, Carleton University  
Dr. James T. Fyles, Consultant  
Dr. Peter Read, Geotex  
Dr. Paul S. Simony, University of Calgary  
Dr. David A. Shaw, Chevron Canada

The course will be based in Nelson, B.C. and fieldwork will be carried out on the Sheep Creek Anticline and in the Salmo Lead-Zinc belt or the Phoenix-Granby copper pit area of southern British Columbia.

The eight day course will be limited to 20 participants and will have a tuition of approximately \$600 to cover instructor's fees and expenses. Travel, accommodation and meals for the participants will be extra.

Those interested in the course and wishing further information are asked to contact, as soon as possible:

Dr. D.A. Shaw  
500 - 5th Avenue S.W.  
Calgary, Alberta T2P 0L7

### Applied Ore Microscopy

Dr. Richard D. Hagni, of the University of Missouri at Rolla has for many years taught a one-week course, for a limited number of participants, on the application of reflected light microscopy to ore study, beneficiation, exploration and other industrial problems. The course is directed toward both geologists and metallurgists. Dr. Hagni has just completed the most recent edition of the course, but if anyone is interested in more information or news of future course times, they should contact Dr. Hagni at:

Department of Geology and Geophysics  
University of Missouri - Rolla  
Rolla, MO 65401, U.S.A.  
(314) 341-4657

## UPCOMING CONFERENCES

### CIM - Granite-Related Mineral Deposits

This international symposium will be centered at the Lord Nelson Hotel in Halifax, Nova Scotia, Canada, from September 14-22, 1985. It will highlight recent advances in the genesis of granite-hosted mineral deposits by drawing together a diverse group of economic geologists, petrologists and volcanologists. The meeting will focus on the interrelationships of felsic plutonic and volcanic environments, crystallization mechanisms, volatile complexing, and the origin, concentration, and precipitation of granophile metals such as Sn, W, Mo, Ta and REE. This technical program will be complimented by field trips, to such places as Mt. Pleasant (W-Mo), Millet Brook (U), and East Kempville (Sn).

For further information regarding this conference, please contact Richard P. Taylor (technical program) or Jean M. Richardson (general).

Dr. Richard P. Taylor  
Department of Geology  
McMaster University  
1280 Main St. West  
Hamilton, Ont. L8S 4M1  
(416) 525-9140

Jean M. Richardson  
Department of Geology  
Carleton University  
Ottawa, Ontario K1S 5B6  
(613) 231-2621

#### Geocongress '86

To commemorate the centenary of the discovery of the Witwatersrand Goldfield, the Geological Society of South Africa plans an international earth science congress in Johannesburg, 7th to 11th July, 1986. The principal thrust of the Congress will be the geology of the Witwatersrand Goldfield, including a historical review of the genetic controversies regarding this greatest of all known gold-fields. Many other topics of more general interest will be covered. Further information may be obtained from:

The Symposium Secretariat S339  
CSIR  
P.O. Box 395  
Pretoria 0001  
Republic of South Africa

#### FIELD TRIPS

##### MDD Field Trip to Replacement Deposits of Mexico, February 18 - 28, 1985

From all reports the Mexican field trip was a roaring success. Ken Dawson has prepared the following report for the information of all of us not fortunate enough to attend.

A field trip to visit the classical Mexican replacement deposits - the skarns, mantos and chimneys of the Sierra Madre Oriental - was first proposed by Amador Osoria at the termination of the 1983 MDD tour of Mexican precious metal deposits. At that time Ing. Osoria, Chief Geologist of Industrial Minera Mexico, S.A. extended an invitation to visit several of the IMMSA replacement deposits that was accepted readily on behalf of the GAC by Fred Felder of UMEX and Ken Dawson of the GSC, both of whom had familiarity with Mexican and northern Cordilleran skarn and replacement deposits. The proposed tour would provide Canadian geologists with an opportunity to study prime examples of structurally and stratigraphically controlled Ag-Pb-Zn replacement deposits that could not be experienced at home, at a time of exploration interest in the deposit type due to the recent Midway discovery in northern B.C.

With the enthusiastic support of the 'Mexican Connection' who had proven invaluable in organizing and leading the precious metal tour, i.e. Dave Coolbaugh, consultant, Mark Romoff, Canadian Embassy and Amador Osoria, plans were made to visit seven replacement deposits in northern and central Mexico. Thirty-seven participants, predominantly from British Columbia, assembled in Mexico, D.F. on February 18, 1985 then flew north to Chihuahua to start the tour by chartered bus.

The Ag-Pb-Zn replacement deposits of the Sierra Madre Oriental are hosted by thick Albian (e-mK) shelf limestones within a mJ-dK transgressive marine sedimentary sequence. These marine beds, together with an underlying uTr-mJ rift assemblage of redbeds and evaporites, were deposited as an overlap assemblage upon the Proterozoic to Paleozoic Sierra Madre and Chihuahua basement terranes of Campa and Coney during and following the opening of the Gulf of Mexico. The Mesozoic beds, deformed and faulted during the Laramide orogeny, were overlain by early Tertiary calc-alkaline, mainly rhyolitic, volcanic and volcanoclastic rocks and intruded by Eocene to Oligocene subvolcanic granitoid stocks and dykes that marked the eastern culmination of a migrating Laramide magmatic arc.

The Santa Eulalia (IMMSA) and Naica (Fresnillo) camps visited February 19 and 20 are prime examples of skarn-replacement deposit morphology with dozens of manto (essentially two dimensional) and chimney (generally elliptical cross section) ore bodies. Both are large camps. Sta. Eulalia has produced 37 million tonnes of ore since 1707 and at least 10 million tonnes of reserves exist. The average grade is 8.4% Pb, 7.2% Zn, 330 gm/t Ag with locally significant values in Sn, Cu, V and Au. Naica has produced 15 million tonnes of sulphide ore since 1951 at an average grade of 13% Pb, 10% Zn and 400 gm/t Ag. Reserves of 4.6 million tonnes are somewhat lower in grade at 4.6% Pb, 3.9% Zn, 153 gm/t Ag plus 0.42 gm/t Au, 0.12% Woz.

Mantos in both deposits show well developed skarn calc-silicate mineral assemblages, with both prograde and retrograde zonation. Sulphide-rich, calc-silicate-deficient chimneys arise from the mantos along late fractures. Mantos tend to be richer in Ag and Fe (pyrrhotite), chimneys in Zn and total sulphides (pyrite). Manto development in both camps is controlled by similarly altered and mineralized Oligocene (26 Ma) felsite dykes that intrude steeply dipping normal faults that flank and cross-cut folded, domal structures in the host limestones. Late cassiterite-bearing chimneys at Sta. Eulalia with associated topaz, fluorite, specularite, tourmaline and wolframite may be related to a belt of topaz-rhyolites in the district.

In addition to offering an excellent opportunity to study the evolution of a skarn-manto-chimney system, mines in both districts are a mineral collector's delight. A highlight of the tour was a visit to the 'Cave of Swords' with 2-metre clear selenite crystals.

After an overnight stop in Torreon, the group travelled 90 km south to the Velardena district to visit the Sta. Maria deposit of IMMSA. Elements of the geologic setting were familiar: an early Cretaceous limestone hostrock, folded and domed in a northwesterly trend and intruded by an Oligocene granitoid stock and related dykes. However, unlike the deposits previously visited, at Sta. Maria skarn calc-silicate gangue is sparsely developed, and orebodies form as replacements of both a trachyte dyke and adjacent limestone. Reserves at Sta. Maria are 1 million tonnes of 8% Zn, 4% Pb and 150 gm/t Ag. The adjacent, generally smaller IMMSA and ASTUMEX deposits include skarn, manto, chimney and vein types, with compositions of the metasomatic and replacement types including Ag-Pb-Zn, Zn and Zn-Cu-Ag-Au, and the younger vein type, Pb-Ag and Sb.

Enroute to our overnight stop in Durango, a short side trip of general interest was made to Avino Mines, a Vancouver-based company in production since 1979. Not a replacement-type deposit, the steeply dipping tabular orebody occupies a silicified shear zone and fault breccia along a contact between Eocene andesitic flows and tuffs and underlying granitoid rocks. The quartz-hematite-pyrite-chalcocopyrite stockwork ore contains an average of 1% Cu, 5.5 oz/t Ag, 1 gm Au and minor values in Pb within the open pit reserves of 5 million tons. With substantial proven and probable reserves in sight the company has embarked upon an expansion program which will double their present capacity of 700 t.p.d.

The morning after an authentic Mexican dinner and entertainment in Durango, the group travelled 100 km southeast to the San Martin mine of IMMSA. The main orebody is localized by three large (average 5 m wide and 900 m deep) intersecting veins within skarned Albian limestone, subparallel to the western contact of a mid-Eocene (46 Ma) granodiorite stock. The large deposit, 25 million tonnes of 5% Zn, 1% Cu and 120 gm/t Ag is mined at 2000 t.p.d.

Lateral sulphide and calc-silicate mineral zoning is well developed. Copper-rich veins tend to root

in a bornite/chalcopyrite-rich skarn close to the granodiorite contact which gives way successively outward to sphalerite/chalcopyrite and sphalerite-rich skarns, then galena-stibnite at the outer skarn/limestone contact. The skarn closest to the intrusive contact, barren saccharoidal quartz grades outward to pyroxene/garnet (ferrosalite/And<sub>63</sub>-Gros<sub>35</sub>) skarn which contains replacement manto orebodies and itself passes outward to a retrograde(?) tremolite-garnet assemblage. Veins and mantos, with essentially identical mineralogy, are obviously related genetically. Widespread tremolite-calcite skarn is of thermal rather than metasomatic origin. Anomalous vertical mineral zonation that involves Pb increase (and Cu-Zn-Ag decrease) with depth indicates that at least two periods of mineralization have occurred.

After an overnight stop in Zacatecas the group bussed 265 km northwestward to the Charcas mine of IMMSA. Several limestone units in a middle Cretaceous sedimentary sequence are intruded by a mid Eocene (46 Ma) quartz latite stock and cut by the principal ore-controlling structures, fissure veins near the stock contact. Wollastonite-quartz skarn is developed extensively, with minor amounts of axinite and andradite. Primary metallic mineral zonation laterally outward from the stock contact follows the classical Barnes sequence: Ag + Fe sulphides, Au, Zn + Cu sulphides, Sb-Bi-Cu-Ag in tetrahedrite, PbS, Sbs<sub>2</sub>. The boron minerals axinite, danburite, datolite and tourmaline correlate closely with Zn. Production of 1500 t.p.d., at an average grade of 6.2% Zn, 1.3% Pb, 0.4% Cu and 135 gm/t Ag, is being expanded to 3500 t.p.d.

After an interesting surface tour of local geology and old showings, the thirsty group had a Carta Blanca break in the town of Charcas (see photo p. 1), enroute to San Luis Potosi for the night. The mines were closed on Sunday, the seventh day of the tour, so the time was put to good use in travelling 356 km southeast to Zimapan. Sightseeing stops were made at the old colonial town of Queretaro and at a market in Huichapan. At Zimapan, travellers were accommodated in a picturesque renovated nineteenth-century smelter called, appropriately, La Fundicion.

The Zimapan district includes dozens of small replacement deposits hosted by the lower Cretaceous El Doctor limestone within a folded upper Mesozoic sedimentary sequence that trends northwest and is overturned to the northeast. A notable feature of Fresnillo's El Monte deposit is the large proportion of low grade Ag-Pb-Zn ore that is disseminated within a 20 m thick quartz monzonite dyke. Ore grade increases toward the hangingwall of the dyke, and skarn orebodies also are thicker (5 m vs 1 m) along the hangingwall contact. The grossularite-andradite-wollastonite skarn is replaced, in order, by pyrrhotite, pyrite, arsenopyrite, chalcopyrite, sphalerite, galena and argentite. Pb and Ag values decrease with depth, whereas Cu, Zn and Fe tend to increase slightly. The mine is operated at about 400 t.p.d. at average grade 2.6% Zn, 1.3% Pb, 0.6% Cu and 160 gm/t Ag.

Half of the group, who visited Fresnillo's La Carrizal mine alternately due to space limitations underground, collected fine specimens of Ag-rich acicular bouldngerite-jamesonite ore from a late vein that cut the main Zn-Pb skarn. On the return to San Juan del Rio that night, a visit to the shop of a local opal miner allowed the mineral collectors in the group to acquire some of those gemstones indigenous to the region.

The last mine to be visited, La Negra of Penoles, is similar to other deposits to the south in the Zimapan district in that replacement orebodies in folded lower Cretaceous El Doctor limestone are localized by a swarm of upper Eocene intrusions. The predominantly dioritic bodies have generated an early stage skarn mineral assemblage of spurrite and borospurrite indicative of temperatures of 800-

890°C. Successive stages include hedenbergite endoskarn and a broad zone of wollastonite exoskarn that grades outward to andradite/grossularite and hematite.

Metallic mineral zonation and paragenesis are similar to those at El Monte with the exception of hessite (Ag<sub>2</sub>Te) occurring as the principal silver mineral. Silver grades vary considerably among the several La Negra orebodies, and copper and tungsten are significant in some deposits. Reserves total 2 million tonnes of about 2.5% Zn, 1.2% Pb and 150-330 gm/t Ag.

The tour returned to Mexico, D.F. mid-day of February 27 after ten long days of stimulating geological visits. Participants dispersed on shopping and sightseeing outings for the afternoon, then re-convened at the Canadian Embassy that evening for a wind-up reception. The efforts of Mark Romoff, Councillor and Allan Stewart, Minister of the Commercial Section to bring the Canadian delegation together socially with senior representatives of Mexico's mining, geological, financial and business communities were appreciated by all parties. We expressed our gratitude to Mark Romoff and his staff for their excellent organization of hotel and bus reservations.

A special vote of thanks was extended to Dave Coolbaugh and Amador Osoria whose outstanding work in organizing and leading the tour was the most important factor in its success. Their personal contacts with the staffs of host mines went a long way in assuring the friendly and informative guidance and gracious hospitality awarded the visitors at each stop. Among the accolades received were numerous requests for another tour in two years' time. Any volunteers, amigos?

K.M. Dawson

#### Spain/Portugal - April '86

Plans for the 1986 MDD field trip to Spain and Portugal are well underway. The level of interest among members is high judging from the encouraging response to the announcement in the last "Gangue". The organizing committee consists of the following personnel:

I.A. Paterson Cominco Ltd. 700 - 409 Granville St. Vancouver, B.C. V6C 1T2 (604) 682-0611 loc.2255 Telex: 04-507730	Scott Swinden Dept. Mines & Energy P.O. Box 4750 St. John's, N.F.I. A1C 5T7 (709) 737-2769 Telex: 016-4724
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Bruce Winfield  
Boliden de Espana S.A.  
Hermosilla No. 77-2nd Floor  
Madrid-1  
Spain, Espana  
Tel: (91) 435.68.89

The tentative itinerary includes the following districts:

- 1) Panasqueira (Sn, W): Western Europe's largest tungsten producer - horizontal veins associated with cupola of Hercynian granite.
- 2) Salave prospect: disseminated gold in altered portions of granodiorite and contact rocks.
- 3) Reocin: Zn, Pb, Fe mineralization associated with early Cretaceous dolomitic reefs.
- 4) Rubiales: Zn Pb mineralization occurs in ore shoots in a narrow vertical structure which is intricately folded, silicified and brecciated.
- 5) Almaden: world's most important Hg producer. Hosted in Devonian quartzites.

6) Pyrite Belt: world famous pyritic massive sulphide belt extending from Spain across to Portugal. We hope to visit some of the following deposits: Cerro Colorado, Aznalcollar, Tharsis, Neves Corvo, Aljustrel. Visits are of course dependent on obtaining permission from the various mining companies. Trip leaders are still in the process of being selected.

Details of the proposed trip are as follows:

**TIMING:** Meet in Lisbon on Monday, 14 April 1986  
Depart from Lisbon on Monday, 28 April 1986

**TRAVEL:** CP Air offer flights to Lisbon departing from Toronto on Sunday and Tuesday evenings and returning to Toronto on Mondays and Wednesdays. It is hoped that we can arrange group excursion rates out of Vancouver, Toronto and Montreal. Some participants may wish to make their own travel arrangements.

**COST:** Cost estimates are difficult to make accurately because of variable inflation and exchange rates. The following are considered reasonable estimates (late 1984 prices): Accommodation (14 nights - double occupancy), tourbus, breakfasts, lunches and guidebook: \$1000

Air fare (excursion rate)	
Toronto-Lisbon	\$ 819
Vancouver-Lisbon	\$1029

Participants will be contacted at a later date once costs are finalized.

Participants will be selected on a first-come, first served basis. Thirty-five positions are available. At present 16 names are on the list. A deposit will be required in September.

Persons interested in attending the trip should fill out the form, printed at the end of this issue and return it to Ian Paterson at Cominco.

#### Brazil - Nov. '86

Luca Riccio of Anaconda in Vancouver is presently planning an extensive field trip to study aspects of geology and mineral deposits of selected areas of the Brazilian Shield. Present plans are not yet firm, but Luca is attempting to line up visits to an impressive array of deposits including representatives of stratabound and vein gold, ultramafic hosted copper, carbonate and clastic hosted lead-zinc, tin, chrome and nickel-copper in mafic and ultra-mafic rocks.

Luca would welcome inquiries and expressions of interest. Please contact him at:

Anaconda Canadian Exploration Ltd.  
1600 - 1500 West Georgia Street  
Vancouver, B.C. V6G 2Z6  
(604) 688-4474

#### BOOK REVIEW

An integrated model for the origin of Archean lode gold deposits, A.C. Colvine, A.J. Andrews, M.E. Cherry, M.E. Durocher, A.J. Fyon, M.J. Lavigne, Jr., A.J. Macdonald, Soussan Marmont, K.H. Poulsen, J.S. Springer and D.G. Troop: Ontario Geological Survey Open File Report 5524, 98 pages, 7 tables, 53 figures, 2 appendices.

Reports prepared by committees are likely to be vague boring and incomprehensible. This report, by 8 Ontario Geological Survey workers and 3 others, is a succinct and concrete contribution to current debate on the origins of gold deposits. Those who have a need to understand gold deposits and their

origin should be appreciative of the effort put into this report and will readily overlook its numerous typographic errors that may be ascribed to the rapidity of its production.

The book is coil bound and because its numerous linedrawings, maps, charts, graphs and tables are on unnumbered pages its total length is close to 150 pages. A 20 page list of references contains a high proportion of entries from the last 5 years.

An introductory chapter poses an important question that the report addresses; "is there one fundamental genetic type, or are there several types" of Archean gold deposits generated by a variety of processes?

Chapter II deals with lithological association and timing, drawing from ongoing investigations by the contributors and reviewing work from an earlier era of high gold production in Ontario. It is noted that much of this earlier work does not provide the "geological parameters necessary to determine a complete sequence of events, including deposition, intrusion, deformation and alteration," required to permit effective genetic models to be developed. The chapter continues "(1) to provide a general description of form and lithological association of several gold deposits in the Superior Province; and (2) to demonstrate that there is a consistent relative age of mineralization which is associated with extensive wallrock alteration."

Chapter III, roughly half the volume, discusses the "systematics of gold deposits" under six headings: (1) Structural Setting, (2) Alteration, (3) Felsic Magmatism, (4) Absolute Timing, (5) Fluid Inclusion and Light Stable Isotope Properties, and (6) Sulphidization, Carbon and Deposition of Gold.

Structural Setting describes regional setting and under local setting discusses the importance of brittle and ductile deformation and the transition from one style to the other which is evident in a number of Superior Province gold camps or mines. Alteration deals with the inherent characteristics of the alteration that is typically associated with most Archean gold deposits and discusses the fundamental variables which include: lithology, P-T conditions and the interrelationship of alteration and permeability. The parameters of alteration typically developed around deposits in mafic and ultramafic, intermediate to felsic, and chemical sediment lithologies are described.

Sections follow on: Felsic Magmatism, where it is suggested that this is a fundamental part of gold deposit formation; and on Absolute Timing where it is suggested that gold deposit formation may be a unique and worldwide phase of Archean crustal development. Figure 26 compares production of gold from the South African, Western Australian, and Canadian Archean blocks and is used to support the conclusion that a fundamental metallogenic difference exists between the period between 3000 and 2500 Ga when most of this gold was deposited and the rest of Archean time. The Pilbara however is probably not much more than 1/10 the area of the Yilgarn, and perhaps only 1/40 the area of the Superior Province. Would Pilbara production be 40 times larger if that block were as large as the Superior? On the other hand although the Slave Province is only 1/10 the size of the Superior Province slightly over 80% of its gold has been won from a portion of the upper formation of the Kam basaltic pile that measures no more than 2 by 10 km. An area of approximate size in the Yilgarn, the Golden Mile at Kalgoorlie, has given up almost 5 times as much gold as the Yellowknife Mines. Province or worldwide patterns drawn from data on production should not be allowed to obscure these far more astonishing variables in gold productivity.

Chapter III continues with sections on: fluid inclusion and light stable isotopic properties, and

sulphidation, carbon and deposition of gold. A summary emphasizes the importance of iron sulphide, particularly pyrite in the epigenetic deposition of gold claiming that: "The fixation of gold is partly a function of the surface characteristics of pyrite.", and noting that the pyrite associated with gold is impure. Commonly with arsenic substituting for sulphur, fine grained and porous or forms skins on generally barren euhedral grains.

Chapter IV presents the integrated model promised in the title. Following a summary of 6 similarities shown by Superior Province deposits which: (1) post-date alkaline magmatism, volcanism, and most deformation, (2) formed in consistent tectonic environments where local structures controlled deposition within large scale deformation zones, to develop (3) a common zonation of alteration minerals and of metals in (4) common association with felsic intrusions to produce (5) a consistent age of mineralization throughout individual crustal blocks and (6) gold deposition was from fluids of like composition aided by fluid-rock interaction.

From these similarities the basics of a model are deduced: a large volume of fluid flowing from below through the deposition site with permeability that follows regional structures produced by deformation.

Twenty-one deposit characteristics described in the previous chapters are tabulated and discussed briefly. Local variations are emphasized in otherwise homogeneous rock packages, sulphides, and certain carbonates believed formed from the gold bearing solutions. These have long been considered important exploration guides.

Source and transportation routes are hypothesized as, respectively, the lower crust undergoing granulite metamorphism and major deformation zones along which magmas also ascended into the upper crust. Some may have difficulty rationalizing post-magma gold deposition by fluids streaming up through deformation zones through which large quantities of magma have already passed. But then practically anything is possible at depths from which the only hard data obtained is geophysical.

It is claimed that the model proposed provides a framework for: (1) mineralization after the dominant calc-alkaline volcanism that is associated with cratonization by granulitization of the lower crust; (2) CO<sub>2</sub>-dominance of the hydrothermal fluid; and (3) association of many deposits with alkaline magmatism and with emplacement of dioritic to granodioritic batholiths.

The final contention that such a "model presents the researcher in Archean geology with exciting challenges for the remainder of this decade." will be received with as much or more agreement than some of the more contentious suggestions made elsewhere in this book. This is particularly true for those who work in Archean terrains containing numbers of deposits and hundreds of showings which do not share some of the important characteristics of Superior Province deposits, and may require significantly different timing relative to intrusion and deformation.

W.A. Padgham

ACKNOWLEDGEMENT

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MDD FIELD TRIP TO SPAIN AND PORTUGAL

APRIL 86

REGISTRATION FORM

NAME: \_\_\_\_\_ AFFILIATION: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

TELEPHONE: (BUS.) \_\_\_\_\_ TELEX: \_\_\_\_\_  
(HOME) \_\_\_\_\_

- 1) I am interested in taking part in a group excursion flight to Lisbon (probably 13th April returning on 28 April) starting from:

Tick where appropriate.

Vancouver \_\_\_\_\_ Toronto \_\_\_\_\_ Montreal \_\_\_\_\_

- 2) I will make my own travel arrangements to and from Lisbon \_\_\_\_\_