Argentina is a large country, 2,780,000 square km, situated along the temperate Atlantic coast of South America. It stretches from the tropical Province of Formosa at 22°S. to the Province of Tierra del Fuego at 55°S. — a distance of 3800 km. Population is concentrated on the Atlantic seashore, although interior cities such as Mendoza and Córdoba are important agricultural and mining centers. Argentina is a democracy with president Carlos Menem's current term expiring in December, 1999.

Argentina is self-sufficient in oil and gas, has vast uranium resources and a well-developed non-metallic industrial minerals sector, but is considered underexplored for metallic minerals. Ninety-five percent of all the mineral occurrences known today were known in 1909 (Stappenbeck, 1910 and 1918). Renewed exploration campaigns from 1960 to 1977 and more recently since 1992 have resulted in a surge of discoveries and increased understanding of Argentina's potential mineral wealth.

In 1990, the Menem government started to privatize government-controlled resource industries: oil, gas and minerals, but not uranium and coal. In 1993, Argentina implemented a new Mining Investment Law that offers attractive incentives for exploration and mining that include financial and tax guarantees. By 1995, more than 50 foreign mining companies were engaged in exploration in Argentina.

Argentina is host to a spectrum of mineralized geological environments from Proterozoic to Recent that includes possible eastward extensions of Chile's prolific El Indio and Maricunga gold belts, porphyry copper deposits, and terranes similar to those of the western United States that have undergone continental compression and extension. With well-directed exploration, potential to discover significant new ore deposits in Argentina is excellent.

METALS EXPLORATION — A BRIEF HISTORY

It is widely believed that the Quechua and earlier peoples mined and exported silver and perhaps gold from northern Argentina to Perú. Their trails, still visible, traverse the length of the eastern Andes from Bolivia to Mendoza Province. First recorded mining was done by Spanish Jesuit missions beginning in the mid-1500s. Veins at Paramillos (de Uspallata) have yielded 15 million ounces (M oz.) of silver over the past 300 years. Gold workings developed in altered sedimentary rocks at a Jesuit camp at Guallilán date from the late 17th century. Please refer to Figure 1 and Tables 1 and 2 (page 7) for district, deposit, and prospect locations and Figure 2 (page 8) for province locations.

Modern exploration can be divided into two eras: pre- and post-1960. Pre-1960 metal mining focused on high-grade precious and base metal veins and stratiform deposits such as the Mina Angela Ag-Pb-Zn-Au vein, Farallón Negro Mn-Ag-Au vein, and El Aguilar sedex massive sulfide deposit. Vein gold was produced on a small scale in northern Argentina during the early 1900s from Rinconada and Eureka in the Santa Catalina district in Jujuy, Rio Blanco in La Rioja, and Incahuasi in Salta Province. Arsenic was mined by English settlers at Tocota and Carrizal, San Juan Province. All mines were closed before or during World War II. Gold placers discovered in Tierra del Fuego during circumnavigation of Cape Horn in the 1500s have produced sporadically, as have small gold placers throughout Patagonia, the Cordillera and the Pampean ranges.

Beginning in the 1960s, the United Nations and Fabricaciones Militares (mining arm of the Argentine military) collaborated in a ten-year mineral reconnaissance program to aid mineral development. The program identified numerous new metallic, non-metallic and industrial mineral occurrences, and discovered dozens of porphyry copper prospects. Several of the porphyry prospects are now being developed: Bajo de la Alumbrera, Paramillos Sur, San Jorge II, Mi Vida (Aguas Rica), Campana Mahuida, and others (United Nations, 1968; United Nations, 1970).
FROM THE EDITORS

The art—and science—of economic geology has undergone numerous important changes since early peoples, some of whom were de facto the earliest geologists, became aware of those essential properties characterizing a rock containing something of use or of inherent value. Most of these changes were engendered through the recognition that some aspect of what we now call “economic geology” could benefit from incorporation of appropriate aspects of science. This collaboration contributed to—and improved—one’s understanding of the geological, geochemical, or geophysical setting of a mineral occurrence. Ore deposits were distinguished from mineral occurrences by adding the economic-technologic requirement that a mineral resource be recoverable at a profit using existing technology and under current economic conditions.

It is very evident that economic geology is once again undergoing an important change, utilizing ideas, according to the requirements of society, and embodying a condition which dramatically changes the definition of “economic” for many mineral deposits. The incorporation of environmental considerations at the exploration, development, production, and post-mining stages of the mineral resources supply process is now essential.

As economic geologists, we have the responsibility to provide earth scientists, engineers, and government regulatory agencies with information concerning the detailed geologic and geochemical characteristics of mineral deposits required to assess the total costs associated with economic geologists. We invite new items and short articles on new challenges and new opportunities; we can seek employment not only as explorationists, mine geologists, and consultants, but also as environmental geochronologists and regulatory personnel. What other areas await us as “economic geology” evolves to accommodate new challenges? How should we prepare ourselves—and our students—for these challenges?

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Due to space limitations, Geoff Plummer’s regular column on Economic Geology and the Environment and Hayden Murray’s second article on Industrial Minerals will be held until the July issue.

FOR CONTRIBUTORS

The SEG Newsletter is published quarterly in January, April, July, and October by the Society of Economic Geologists. We invite new items and short articles on topics of potential interest to the membership. If you have questions on submission of material, please call the SEG office at (303) 797-0323 or FAX details to 303-797-0472.

Format: Manuscripts should be double-spaced. If possible, please submit paper copy AND a computer diskette in DOS format, using WORD or WordPerfect. Pertinent illustrations will be accepted in camera-ready form at publication scale. Authors are asked to obtain permission to use any copyrighted materials. All contributions may be edited for clarity or brevity.

Advertising: Paid advertising is solicited to help offset publication and mailing costs; for rates, contact the Executive Director. Employment opportunities for economic geologists will be listed free of charge.

DEADLINE FOR LETTER

#26: May 20, 1996
FROM THE EXECUTIVE DIRECTOR

On March 31, the Society completed its 75th Anniversary celebration year. Some of the events and activities of the year have been publicized in previous issues of the Newsletter, and others are reported in this one. The highlight of the year was the internationally attended "Carbonate-Hosted Lead-Zinc" conference held in St. Louis, Missouri last June. This major conference, organized by SEG with several co-sponsors, was highly acclaimed by those who participated. Three SEG Guidebooks covering the geology of carbonate-hosted lead-zinc deposits in Ireland (v.21), North America (v.22) and Australia (v.23) were published. A conference volume, edited by Don Sangster and consisting of fifty-three manuscripts of papers presented at the meeting, is in preparation and will be published by the Society. A mid-year publication date is anticipated.

The recent meeting with the Society for Mining, Metallurgy and Exploration (SME) in Phoenix attracted strong SEG participation. The two SEG-sponsored field trips were filled and 63 individuals registered for the "Southwest Pacific Rim Gold-Copper Systems" short course. Tony Naldrett presented the SEG Distinguished Lecture, "Critical Factors in the Formation of Magmatic Ni-Cu Sulfide Deposits as Illustrated by Those at Noril'sk, Sudbury, Jinchuan, Kamblada and Voisey's Bay." Following the lecture, a sellout crowd of 185 attended the SEG luncheon and heard President-Elect Nielsen (substituting for President Skinner, who was in Australia) preview some of the exciting events coming up in the near future. These include the greatly anticipated Neves Corvo Field Conference in Portugal (May '97); the Carlin, Nevada Field Conference (Oct. '97) prior to the Salt Lake City GSA meeting that will include technical sessions on "Metalloceny of the Oquirrh and Wasatch Ranges" and a corresponding post-meeting field trip; and, in January, 1998, an exploration conference, "Pathways to Discovery," co-sponsored with the British Columbia & Yukon Chamber of Mines in Vancouver, British Columbia, Canada. The Society and SME are also investigating the possibility of co-sponsoring a conference on international exploration (technology, methods, case histories, etc.) to be held once every two or three years in venues accessible to exploration's international community. A number of new SEG publications are being planned, including the aforementioned "Carbonate-Hosted Lead-Zinc Conference" volume, Guidebooks for each of the forthcoming field trips (including Neves Corvo), new Special Publications (including the revised, second edition of Ore Reserves Estimates in the Real World, and a volume arising from the "Southwest Pacific Rim Copper-Gold Systems" short course), and several new Reviews in Economic Geology, which will revitalize that important series.

COMMON CENTS

I am pleased to report that the Society, the Foundation and the Economic Geology Publishing Company remain in sound financial condition and continue to strengthen.

Last year, in conjunction with the Finance Committee, the three organizations began investing their funds with strategies tailored to match their individual needs—basically a combination of matching fixed income to operating expenses and investing the balance of funds for growth. Now, I want to report on the operating and financial results for the three entities in the context of the investment strategies implemented a year ago.

First, let me discuss costs. Costs, in this context, do not include overhead but are the costs for programs and activities such as publishing, field trips, conferences, grants and subsidies, for which we want to expand services but reduce costs. Last year we talked about the savings achieved on publishing costs via computerization. Overhead or administrative expenses are also being addressed, and the cost of health insurance for employees of the three organizations has been reduced. By asking insurance agencies to bid on a combined Denver/New Haven/El Paso package, health insurance costs have been cut from $15,000 to $11,000—a savings of $4,000—while adding benefits and increasing the number of employees at PUBCO. That's a 27% reduction in cost!

Turning to the organizations, the Society's fixed income climbed by $10,000 in 1995 to $45,000, and the Society ended the year with an operating surplus of $21,000. Capital gains contributed an equal amount, so the Society finished 1995 with a surplus of $42,000. The capital gains from stock sales were all reinvested. In the Foundation's General Fund, awards, grants, and expenses of $75,000 were offset by fixed income of $75,990, for a surplus of $200. The McKinstry and Hickock-Riddiford funds earned $5,300 in dividends and interest, such that the total operating surplus was $4,000. Then, adding capital gains of $69,000 and results of the fund raising, described elsewhere in this Newsletter, the Foundation finished the year $291,000 stronger than the previous year.

PUBCO asked the Finance Committee to develop a portfolio that would generate fixed income adequate to offset operating expenses. PUBCO's "Operations Income" (revenues from the sale of back issues, page charges, offset and color pages, etc.) would then produce a surplus. With a limited amount of capital to invest and recalling that interest rates were coming down fast last March, the fixed income received was slightly less than projected. Nevertheless, the strategy is working. PUBCO's fixed income was $74,000, whereas operating expenses were $95,000, so the fixed income brought PUBCO within $21,000 of breaking even. However, PUBCO's Operations Income brought in $55,000, resulting in a net surplus of $74,000. Including capital gains of $118,000, PUBCO showed a surplus of $192,000 for the year. As with the Society, the capital gains from stock sales were all reinvested.

Broadly speaking for the three entities, the combined operating surpluses totaled $100,000, and capital gains and contributions strengthened the organizations by a total of $500,000. Capital appreciation (unrealized) in the portfolios added another $500,000. The financial assets of the three organizations grew from $4.4 million at year-end 1994 to $5.5 million at year-end 1995, and stand at approximately $5.5 million today. We're expanding programs—the Foundation's budget grew 19% last year and will grow another 20% this year—we're watching the overhead, and, for the Society for the third year in a row, we've managed to avoid an increase in dues. I look forward to reporting to you later in the year about the first half of 1996.
There is an old Chinese curse: “May you live in interesting times.” Ah yes! We certainly do. Last year Congress eliminated the U.S. Bureau of Mines—an agency that paid its way for more than 90 years, increasing mine productivity through research and saving lives with mine safety programs. The U.S. Geologic Survey almost suffered a similar fate, but was saved by action of concerned professionals and by an Interior Department that recognizes scientific excellence and plans to use it to further political aims and environmental agendas. The mineral resource program of the U.S.G.S. is greatly reduced, now consisting mainly of resource assessments and a small program of technical support for a relatively large environmental research program.

U.S. universities and colleges are reorganizing to specialize in environmental geology and global change. Hard rock geology is taking a back seat; field geology is not emphasized; and economic geology professors who retire are not being replaced.

Mining and exploration companies have significantly reduced research and professional training of employees. Increasingly, companies need to make decisions that impact the next shareholders report or equity markets. Interest of investors must be kept at high level.

That there are no mineral resource availability problems in our future is a popular perception. One does not have to be a foreign relations expert to identify unstable areas in the world—Russia, China, southern Africa, and the Middle East, to name a few—where political upheaval or military actions can cause serious problems in the supply of needed natural resources. Current plentiful resources may be only a temporary phenomena.

Training and professional growth of future economic geologists concern many in our profession. Where will future exploration technology be developed? The U.S. produces its fair share of explorationists, but more and more, the technology, target concepts, and ore deposit models in use in mineral exploration are being developed by research activities of colleagues beyond the borders of the U.S.

These changes and trends are creating unprecedented challenges and opportunity for the Society of Economic Geologists. They will demand increasing internationalization of Society of Economic Geologists. They will demand increasing internationalization of Society membership and activities. Gaps created by reduced levels of training and research by government, universities and mining companies will have to be filled.

The Society of Economic Geologists recently received five shares of Berkshire Hathaway stock from a donor who wishes to remain anonymous. The stock, which is traded on the New York stock exchange, closed on Friday, March 22nd at US$33,800 per share, putting the market value of the gift at US$169,000. This is truly an extraordinary and unusually generous gift. The gift was given to assist the Society in establishing its own headquarters office, preferably in the general Denver area. At a teleconference meeting held on February 29, 1996, the SEG Executive Committee voted to accept the gift. (This Executive Committee action, along with others taken at that meeting, will be submitted in due course to the SEG Council for ratification.) The shares have been deposited in SEG's investment portfolio account and are being monitored by the Society's financial advisor and the SEG Finance Committee. President Skinner has appointed an ad hoc committee consisting of Paul A. Bailly, Samuel S. Adams and Bruce A. Bouley, with ex officio (voting) members Thomas A. Loucks and John A. Thoms, to investigate various possibilities for establishing a headquarters office for the Society and to make appropriate recommendations to the Executive Committee. The ad hoc committee has been given wide latitude in its charge and will look into various options for a headquarters, including but not limited to, considerations involving site acquisition and construction, acquisition of an existing facility, long term lease of an existing facility, or other alternatives. The recommendations of the ad hoc committee are to be submitted to the Executive Committee for review at its mid-year meeting, and then will be presented to the SEG Council at its annual meeting this fall in Denver. Although the gift was designated expressly for the Society, the contemplated office could also serve the SEG Foundation and the Economic Geology Publishing Company. The Society has acknowledged this remarkable gift and has expressed its great appreciation to the donor.
I am pleased to submit my first report to the membership as President of the Foundation. Perhaps the most notable recent event has been the growth of the Foundation’s portfolio through the fund-raising drive and the efforts of Past-President Barber and fund-raising chairman Roger Newell. Roger has commented regularly in the Newsletter about the drive, and contributors are listed in each issue. Some other initiatives that have been announced here, and in other journals, include the special grants awards from both the McKinstry and Hickok-Radford funds, to be awarded this year. We thank Ernie Ohle for his years of generous service as Special Awards Committee chairman, and thank Don Everhart for taking over after Ernie’s “retirement.” The Membership Subsidy Fund has been implemented, and the first applications have been received and approved by a review committee (Dick Hutchinson, Chairman). The Student Chapter Field Trip Subsidy program has been approved, with the details of its implementation being hatched under the careful incubation of Student Affairs Committee Chairman Pat Williams. And last, but not least, is the imminent completion of the History of the SEG, assembled and edited principally by Gene Cameron and Bill Kelly, but with much input from Burt Boyum, Ernie Ohle, Spence Tidley, Jack Murphy, Sam Adams and Dick Hutchinson.

The international growth the Society has enjoyed in recent years promises a new level of excitement, and opportunity for enhanced dialogue with colleagues from around the world. It is fitting, then, that with this growth and these new initiatives that the Society renew its appeal to the membership to help in the fund-raising in every way possible.

Fund-Raising Progress Report

“Every Member Counts” is the theme of the 75th Anniversary fund drive as the drive heads into its second year. The objective of this drive is to double the value of the Foundation’s investment portfolio, which totaled $1.2 million at the beginning of the drive in January, 1995.

The first three months of 1996 continued to be important months for the Foundation’s fund drive as companies and individuals were able to budget their pledges and contributions into the 1996 fiscal year. Contributions and pledges now total approximately $84,000 with SEG members accounting for $112,000 and corporations for $272,000.

We want to extend our gratitude and thanks to each and every person and organization who has pledged or contributed to the SEG Foundation fund drive. To date, however, only 9% of the membership has entered a pledge or a contribution. “Every Member Counts” not only in a financial sense, but in a commitment sense to the programs, objectives and opportunities available to the Society.

SEG is seeking to obtain a major foundation grant that may match part or all of our contributions and pledges. Receipt of a major foundation grant commonly depends on the percentage of individual members that have contributed to an organization’s fund drive. Before a major foundation will commit funds to a society such as SEG they will ask, “What percentage of your membership supports your fund drive? The higher the percentage of contributors, the better the chance to receive the grant. In the eyes of a major foundation, it is not the amount of individual contributions that counts; rather, what really counts is that a large percentage of the membership supports a fund-raising campaign. Simply, we need more than 9% membership participation! This is why we urgently request each member to make a contribution or pledge regardless of the amount. Thus, “Every Member Counts.”

Again, if you have already made a contribution/pledge, we want to sincerely thank you; if you have not or know of someone who has not, we would encourage you to contact that person and/or make a personal contribution so that you can be counted with the rest of the membership.

Please send your contribution to:

SEG Foundation
5808 South Rapp Street, Suite 209 • Littleton, CO 80120 U.S.A.
Roger A. Newell
Chair — 75th Anniversary Fund-Raising Committee
Immediately following the discovery of high-grade gold at El Indio, Chile in the 1970s (Siddeley and Arendt, 1990), St. Joe-Aguilar started to explore areas in the nearby Argentinian Andes that had undergone acid sulfate alteration: Lama, Tagua, Del Carmen and Zancarrón. Further exploration of volcanic environments in the 1980s resulted in discovery of epithermal gold at Diabillillos in Salta, and Cerro Vanguardia in Patagonia, discovered by government geologists (Gemelli, 1989). Angeletti (1984) describes many known mineral discoveries and prospects in an extensive compendium that is a valuable guide for any modern explorer.

El Aguilar and Farallón Negro (Alto de la Blenda) are the largest producing metal mines in Argentina. Since 1936, El Aguilar has produced more than 25 million metric tonnes (Mmt) of Zn-Pb concentrates (Gemmell et al., 1992). Current production is 1000 tonnes/day of ore containing 7% Zn, 5.5% Pb and 60 to 110 grains per tonne (g/t) Ag (A. Palma, 1993, personal communication).

**Table 1:** Districts, mines, deposits, prospects and areas on Figure 1, listed from north to south.

<table>
<thead>
<tr>
<th>District/Mine</th>
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<td>Farallón Negro (Alto de la Blenda)</td>
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<td>Bajo de la Alumbra</td>
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<td>El Dorado/Montserrat</td>
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<td>Manantial Espejo</td>
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<td>Tierra del Fuego</td>
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**Table 2:** Alphabetized list of districts, mines, deposits, prospects and areas.

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<td>Gualcahui</td>
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<td>San Jorge (I, II)</td>
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<td>Ucrushum</td>
<td>Tierra del Fuego</td>
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**Figure 1:** Precious, base, and ferro-alloy metal districts, deposits and prospects in Argentina.
REGIONAL PHYSIOGRAPHIC FRAMEWORK

The physiographic divisions of Argentina are shown in Figure 2 (in part from Stoll, 1964 and Nielsen, personal communication, 1995), and are described as follows.

- **Andean Cordillera**—a 110-km-wide chain of mountains, the crest of which forms the physiographic divide with Chile. This mountain range, formed by magmatism and uplift along a convergent plate margin since Jurassic time, is the product of subduction of the Nazca plate beneath the South American continent. Igneous rocks of Permian to Triassic age form the basement of this mountain chain. Average elevation of the Andean Cordillera is 4600 m.

- **Precordillera**—a belt about 1000 km long and ≥ 250 km wide that underwent large-scale tectonic compression since the Jurassic, and was subsequently modified by extension since mid-Miocene. Locally it is similar to the Basin and Range extensional regime in the western United States. Extension-related Cenozoic volcanism is manifested as numerous calc-alkaline to alkaline volcanic centers, such as Cerro Galán and Cerro Bonete (Figure 1).

- **Pampean and Transpampean Ranges**—almost entirely composed of Precambrian and Paleozoic granitic and metamorphic rocks, sparsely covered by Paleozoic and Triassic continental sedimentary rocks. Uplift along Laramide-style high angle reverse faults formed these mountains. The terrane has been extended an undetermined amount, and may contain metamorphic core complexes. The Pampean ranges degrade topographically to the east and south into the Argentine Pampa.

- **Puna**—a southern continuation of the Bolivian Altiplano. The Puna is a coherent basement block studded with active volcanoes. The plateau (average 4000 m elevation) is dissected by young faults that form numerous closed basins and low mountain ranges with 300 to 400 m relief.

- **Patagonian Plateau**—a tectonically discrete region located south of latitude 40°S. A Proterozoic and Paleozoic metasedimentary and crystalline terrane, it is believed to have been accreted to the South American continent during early Mesozoic time and underlies Patagonia (Ramos, 1988). Widespread Jurassic-Cretaceous volcanic rocks, temporally related to continental extension and the break-up of Gondwanaland, are exposed in structural windows such as the Semonkura (North Patagonian) and Desando Massifs. These masses are separated by tectonic basins that host economically important petroleum, uranium, and evaporite resources of Cretaceous to Tertiary age. The Patagonian plateau averages less than 1000 m in elevation. To the west, the **Patagonian Cordillera**, (average 3000 m elevation) is part of the active “Southern Volcanic Zone” (Cunningham, 1993), an area of Cretaceous to Quaternary calc-alkaline magmatism resulting from ongoing subduction at the Pacific margin.

- **Mesopotamian Plateau**—in northeastern Argentina and extends into contiguous Paraguay and Brazil. Cretaceous flood basalt, the southern continuation of the Paraná volcanic province in Brazil, covers the plateau.

- **Sierras Bonarenses**—two northwest-striking, en echelon outcrops of Precambrian basement that rise above the Buenos Aires Pampas. The Sierras Bonarenses apparently are localized by continental-scale basement structures subparallel to structural trends seen from Brazil to Patagonia.

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FIGURE 2. Physiographic regions and provincial boundaries of Argentina.

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GEOLOGIC AND TECTONIC SETTING OF DEPOSITS

The oldest rocks in Argentina are Precambrian crystalline and metasedimentary rocks of the Lower Proterozoic Transamazonian cycle (2.0 Ga), which are also exposed in Uruguay and southern Brazil (Bermascón, 1987 and 1988). These rocks are exposed in the Sierras Bonarenses structural block, and form a 300 km long belt from Olavarria to Mar de Plata in Buenos Aires Province (Figs. 2 and 3). Recently, companies have completed geophysical surveys in this block to explore for diamond-hosted diamonds.

The Pampean and Transpampean ranges contain Precambrian, Phanerozoic, Mesozoic, and Cenozoic intrusive and metamorphic rocks with a sparse cover of Paleozoic and Triassic continental sedimentary rocks in the western half of the ranges (Miller et al., 1994). For example, Devonian mafic and ultramafic rocks are present within Proterozoic (?) gneiss in San Luis Province, and Tertiary alkali rocks at Cerro Blanco (San Juan Province) intrude Precambrian metamorphic rocks. We suspect that more, as yet undiscovered, Tertiary stocks are hosted by Paleozoic and Proterozoic basement in these ranges. Recent aeromagnetic studies indicate that alkaline intrusive breccia bodies at La Carolina (San Luis Province, Figure 1) extend north into Córdoba Province. There also may be unmapped metamorphic core complexes that expose
Precambrian and Paleozoic rocks in San Juan and La Rioja Provinces.

The Paleozoic history of the PreCordillera is unresolved. Recent faunal studies suggest the PreCordillera shared a marine basin with northeastern North America (Laurentia) in Cambrian time. The PreCordillera eventually rifted, drifted, accreted the Pamatina island arc terrane, and collided with Gondwanaland in mid-Ordovician or Devonian time (the Pamatina orogeny) (Astin et al., 1995). Paleozoic rocks are exposed from Quiraco at the Bolivian border to Viedma, Chubut Province (Figure 3). Accreted Paleozoic rocks extend from Patagonia in Chubut south to Tierra del Fuego (Figure 3).

**Figure 3.** Geological map of Argentina.

Ordovician rocks host significant potential for new discoveries of Mt. Isa-type Pb-Zn-Ag deposits and Cyprus-type copper deposits. The rocks include deep-water shales, limestone, sandstone, and ophiolite sequences of tholeiitic basalt, layered sills, andesitic flows, and ultramafic pods and mélanges. Devonian and Carboniferous arenaceous rocks are poorly mineralized, except where intruded and hydrothermally altered by younger dioritic stocks. Massive limestone of Cambrian to Silurian age in San Juan and La Rioja Provinces may host skarn and/or Carlin-type gold deposits.

The Permian-Triassic Choiyi Group underlies the Andean Cordillera from Argentina and Chile to Ecuador. The Choyoi Group consists of calc-alkaline intrusions and coeval volcanic rocks: felsic and monzonitic intrusive rocks, rhyolitic ignimbrite, and andesite (Gemuts et al., 1992). These rocks form an extraordinarily thick (>10 km) silicic crust and represent the root of a magmatic arc at the continental margin. The sequence was further thickened by compression and numerous thrust faults from Triassic through Holocene time (Kay et al., 1989). The Choyoi igneous complex hosts uneconomic Triassic Cu-Mo occurrences, and is the basement hosting Tertiary Cu-(Au) porphyry and precious metal systems such as the Llano gold-ore system, the Nevada (Chile) gold-ore system, the Collahuasi (Chile) porphyry copper deposit, the Chita porphyry copper (Lara et al., 1993), and the El Salado porphyry-copper-gold system (Figure 2).

Jurassic effusive and pyroclastic volcanic rocks are confirmed by drilling to underlie most of Patagonia and host numerous deposits including the Cerro Vanguardia Au-Ag prospect (Figure 1). Two fault-bounded horsts expose these rocks: the Deseado Massif (Santa Cruz Province) and the Somonkura Massif (Rio Negro and northern Chubut Provinces). The former is a 40,000 sq km trapezoidal block that extends from the Patagonian Cordillera to the Atlantic coast. Volcanic rocks in both massifs evolve compositionally from andesite to rhyolite. Volcanic activity migrated southwards over time, from the Somonkura Massif (210-200 Ma) during early stages of continental rifting to the Deseado Massif (160-150 Ma) (Rapela and Kay, 1988; Fernández and de Barrio, 1994). In the Deseado Massif, the Jurassic basalts Bajo Pobre andesite underlies dacite and rhyolite flows, felsic tuff, ignimbrite, and volcanic breccia of the Chon Aike Formation and tuff and volcanicogenic sedimentary rocks of the Małdive Formation. Auriferous quartz veins cut both the Bajo Pobre and Chon Aike Formations, but do not affect Cretaceous rocks; thus, extension-related mineralization is constrained to a mid-Jurassic age.

During Miocene time, the angle of subduction of the Nazca plate at the continental margin, defined by the Benioff zone, decreased between latitudes 27°S. and 33°S. (Kay et al., 1991; Kay et al., 1993). The resultant "flat slab" geometry caused eastward migration of active volcanism and resulted in a geographically broad distribution of Miocene-Pliocene (15-4 Ma) porphyry-Cu-Au and epithermal Cu-Au deposits over a 250 km wide zone, from the Andean Cordillera through the Pampean ranges (Ramos, 1995). Volcanoes erupted concurrently in the Maringüena and El Indio (Chile) belts from 26 to 6 Ma, with Au-Ag mineralization focused at 14-12 Ma and 9-7 Ma, respectively (Sillitoe et al., 1991; Kay et al., in press). Gold and copper of the same age as El Indio are associated with quartz-sericite-alunite alteration products at Luna, Zancarrón and Río Frio (Cerro Colorado) at the Argentina border (Figure 2). The Olavares volcanic field, 70 km south of El Indio, hosts caldera-related disseminated Au-Ag-ore deposits focused on Au-Ag-orepyrite at Poposa dated at 6 Ma (Bastias, 1991) (Figure 1). Epithermal and subvolcanic gold-copper mineralization at the Argentina-Chile border is largely controlled by northwest-striking extensional structures and dilational zones related to faults (Martinez et al., 1993).

In early Tertiary, western Argentina (PreCordillera, Puna, and the Pampean terrane) was compressed and subsequently extended (Acevedo and Bianucci, 1987). Tertiary grabens in the PreCordillera show evidence of extension by listric and normal faults that in some places are re-activated regional-scale structures formed during crustal shortening. Extensional NW- and NE-striking faults and their intersections localized the intrusion of mineralized porphyry systems along, within, and outside of the graben (or rift) margins. Paramillos, San Jorge II, Chita, and El Salado are examples of copper-(gold) mineralized Tertiary porphyry systems along the Usppalla Graben (Mendoza and San Juan Provinces).

Northwest Argentina hosts Tertiary to Recent composite volcanoes reaching 60 km in diameter, with ignimbrite aprons and central edifices of
ARGENTINA PRECIOUS & BASE METALS

resurgent rhyodacite domes. Megavolcanoes such as Cerro Panizos at the Bolivian border and Cerro Galán (Figure 1) help define a region of active extension in a setting similar to the Valles Caldeira in the Rio Grande rift, USA (Goff and Gardner, 1994). Cerro Panizos hosts newly recognized gold occurrences. Francis et al. (1983), in their discussion of Cerro Galán, show that there exists a clear relationship between rifting, construction of ignimbrite shields, caldera formation, alkaline volcanism, and extension in a back-arc environment. Shoshonitic volcanic rocks and carbonate diatremes also mark this zone of extension (Kay and Gordillo, personal comm.).

DEPOSITS AND OCCURRENCES

Most of the districts, deposits, and prospects in this section are in Figure 1.

Precambrian and Paleozoic Deposits and Occurrences

The Pampean Ranges host most of the notable Proterozoic base and precious metal deposits and occurrences. At Cerro Blanco, Precambrian gneiss consists calc-silicate rocks with boudins of galena-zincite that locally have 21% Pb-Zn over 2 m widths. These occurrences are interpreted to be uneconomic, metamorphosed Broken Hill-type sediment occurrences. Tertiary (? ) polymorphic breccia bodies cut Precambrian rocks at Cerro Blanco and contain en echelon gold-bearing vein quartz and auriferous (30-40 g/t Au) jasperoid in Tertiary shear zones and in contacts of breccia with gneiss and gabbroic host rocks. Associated minerals are chalcopyrite, bornite, chalcocite, hematite and magnetite in breccia and jasperoid, and quartz and chlorite in altered wall rock.

The Sierra de Las Minas vein district, La Rioja Province, is in foliated late Precambrian to early Cambrian granite-gneiss. Discrete structurally-controlled quartz veins (0.5 to 1 m wide, 330 m long) contain free gold and have grades up to 25 to 30 g/t Au and 2% Cu.

In the Cruz del Eje region, Córdoba Province, a gneiss and migmatite terrain host at least 20 quartz veins within fractures. The veins, 0.4 to 0.6 m wide, contain free gold, limonite, hematite, and pyrite, and average 5 g/t Au. The district also contains pegmatite bodies with potential for tungsten.

Ordovician rocks include terranes that may contain Cyprus-type massive sulfide deposits, platinum-bearing mafic intrusive rocks, stratabound sedex Pb-Zn-Ag massive sulfide and skarn deposits.

Pumahuai, El Aguilar and Esperanza are stratabound sediment and vein Pb-Zn-Ag deposits in Ordovician black shale and sandstone. At El Aguilar, Cretaceous stocks intruded the Ordovician strata that host sedex sulfide minerals. The stocks metamorphosed, recrystallized, and redistributed primary stratabound massive sulfides (Brodtkorb et al., 1978; Gemwell et al., 1992; Martin et al., 1994).

In the Helvecia district, La Rioja Province, Ordovician marine metamictic rocks host stratabound and discordant Pb-Zn-Ag-Ba-Mo-UU minerals, shown to be syngeneic by Sr and Pb isotope studies (Brodtkorb and Brodtkorb, 1994). The best metal concentrations apparently are related to Ordovician paleotopographic highs (Brodtkorb, 1979), and are remobilized locally near a Miocene (? ) monzodiorite stock.

In Jujuy Province, La Colorado hosts massive quartz-pyrite lenses, volcanogenic massive sulfide bodies within flat-lying, sheared, altered, metamorphosed Ordovician submarine volcanic rocks. Fabricaciones Militares estimated that La Colorado prospect contains a resource of 8.3 Mmt containing 0.5% Cu, 1.0% Zn and 10 g/t Ag. The Santa Catalina and Eureka placer gold deposits (Figure 1) most likely were shed from Ordovician source rocks.

Las Águilas nickel prospect, San Luis Province, is in amphibolite and feldspathic gneiss that are part of an accreted Devonian (?) ophiolite suite that consists of rocks that range in composition from dunite to anorthosite. Mafic rocks are layered and have a Ni-Cu-Co-rich basal section that contains pyrrhotite, pentlandite, and chalcopyrite. San Nicolás and King Tut are As-Co-Ni-U prospects in Valle Hermosa, La Rioja Province (Schalman et al., 1994).

Mesozoic Deposits and Occurrences

Mineralization of Mesozoic age is concentrated from the central Andean Cordillera south to Patagonia. Precious and base metal deposits, mostly Jurassic and Cretaceous, are found in two tectonic environments: areas of continental rifting (extension) related to break-up of Gondwanaland and the opening of the Atlantic Ocean in Jurassic time (Dalziel, 1995), and the Patagonian Cordillera migmatic arc. The arc includes Late Jurassic, Cretaceous, and Tertiary volcanism related to subduction of the Pacific plate.

Sub-economic Cu-Mo mineral occurrences such as Lihuel Calef are in the eastward projection of Permian-Triassic Chocoyoi-equivalent granite rocks that mark the paleo-continental margin (Figure 3). Triassic granites that contain graphite-style Cu-Mo intrusive Proterozoic basement as far south as southern Patagonia (Marquez, 1994).

In the Desado Massif, the Cerro Vanguardia Au-Ag prospect is in a vein camp that contains more than 60 bonanza-type epithermal quartz veins. Single vein structures can be traced for 20 km on satellite images. The Cerro Vanguardia epithermal veins strike N 30° E, N 40° W and east-west, reflecting regional structural trends and possibly radial and tangential structures of a large eroded caldera imagery. Exploration since 1992 has defined a resource of at least 10 Mmt containing 10 g/t (3 M oz. total resource). Native gold and silver, electrum, argentine, and copper sulfosalts minerals are hosted in repetitively banded silica veins exhibiting vuggy, drusy, and comb textures with locally abundant silica pseudomorphs after barite (rarely anhydrite) and accessory adularia and amethist (Genni, 1989). The principal veins are thicker than 15 m; silicified and mineralized stringer veins cut the ignimbritic wall rock. Ag/Au ratios range from 1:1 to 100:1. Veins thicken and flatten at depth with higher gold grades concentrated in steeply plunging "bolosones" or shoots.

An increasing number of settings for volcanogenic epithermal mineralization are being recognized in the Desado Massif. There is an empirical association of auriferous veins systems such as La Maria vein at Manantial Espejo (Schalman et al., 1994) and La Josefiná veins (Del Blanco et al., 1994; Echeveste et al., 1995) with siliceous sinter, and of the Bajo Pobre vein cluster, El Dorado- Monserrat veins (Echevarria, 1995), and Cerro Chato veins (Giacosa and Genni, 1995) with rhyolite domes. At Rio Pinturas, in a Santa Cruz provincial mineral reserve, gold is disseminated in siliceous tuff spatially related to a rhyolite stock.

The Sumonkura Massif hosts epithermal gold occurrences at Los Menudos (Rio Negro Province) and Paso de Indio (Chubut
Province). Lesser-known precious metal and copper occurrences are in La Cascada and Cerro Gonzalo mineral reserve areas administered by Chubut. Post-dating the early Jurassic Somonkura Massif, disseminated gold and gold-bearing pyritic veins are associated with Late Jurassic-Cretaceous andesitic Cordilleran volcanism. Marquez (1994) documents Late Jurassic-Cretaceous porphyry copper mineralization near Tecka.

The defunct Pan de Azúcar mine, Jujuy, had high-grade concentrations of Pb, Zn, and Ag in 0.7-1 m wide veins of quartz, ankerite, barite, galena, sphalerite, and freibergite. The Cordilleran wall rocks are brecciated porphyritic dacite hydrothermally altered with kaolinite, sericite, and silica. Clay alteration of wall rocks comprises an area of at least 2 sq. km around the deposit. Angelloni (1984) reported a resource of 35,240 t (1.28 m average vein width) with 4.92% Pb, 5.91% Zn, and 377 g/t Ag.

**Tectonic Deposits — Copper and Gold**

**TECTONIC SETTING.** Tertiary metal deposits are considered to be either associated with subduction-related crustal shortening and resultant magmatic activity, or with back-arc crustal extension. Ramos (1995) relates the formation of Tertiary Cu-Au and Cu-Mo porphyry deposits and epithermal Au-Ag deposits to the results of contraction during crustal stacking, “flat slab” horizontal subduction, and eastward migration of the magmatic arc in middle to late Cenozoic. In contrast, we believe field evidence supports a corollary hypothesis: late Cenozoic (15-4 Ma) crustal attenuation and basin development locally controlled magma emplacement. These events resulted in the temporal and spatial association of Cu-Au porphyry deposits and epithermal Au-Ag deposits with an extensional tectonic regime (López and Centeno, 1994; Seggiano et al., 1995).

Porphyry copper, skarn and Carlin-type sediment-hosted deposits are commonly associated with Tertiary calc-alkaline and alkaline intrusions in the PreCordillera of Argentina. It appears that these types of mineralization formed in the late Cenozoic (15-4 Ma) following the mid-Cenozoic (15 Ma) Andean compressional event. Until recently, major areas of extension were not recognized in the PreCordillera (Ramos, 1995); however, field observations and regional aeromagnetic surveys have revealed a tectonic setting similar to that in Nevada, USA.

We recognize large extensional Tertiary grabens and valleys, such as the 250 km long Uspallata Graben bounded by horst blocks of Ordovician, Devonian, and Carboniferous rocks. In places, the horsts are localized by reactivated thrust faults and by linear normal faults. A number of copper deposits are in porphyritic intrusions into basement rocks. Deposits are exposed at graben margins or are buried under shallow basin cover. The sparse age data available indicates intrusive rocks are early to late Miocene (Leveratto, 1976). Intrusive activity controlled by extensional tectonics took place in areas in addition to the PreCordillera — the Puna, Patagonia, and inboard in the Pampean and Transpampean ranges. Acevedo and Bianucci (1987) document extension in the Guayatayoc depression in the Puna with seismic surveys.

**INBOARD DEPOSITS.** La Carolina prospect, San Luis, comprises mineralized diatreme breccia bodies that cut 4 Ma porphyritic dacite stocks intruded along an extensional west-northwest-striking fault. Country rocks are Precambrian granitic gneiss and amphibolite-facies paragneiss. Gold, quartz, and fluorite are in a silicified, polymict breccia near clay-altered dacite phorphyry. In 1989-1990, after drilling 12 targets, Anglo American intersected 10 m of rock containing 9 g/t Au. Historically, Precambrian veins containing scheelite and wolframite were mined at La Carolina, as were small alluvial deposits of gold, tin, and tungsten.

The Farallón Negro alkaline andesitic volcanic complex, Catamarca, is dated at 7-11 Ma (Caelles and McBride, 1971), and hosts the Bajo de la Alumbra porphyry copper-gold deposit — the largest metal mining project under development in Argentina. Bajo de la Alumbra is one of more than six known subvolcanic quartz monzonite porphyry complexes, which include the Bajo del Durazno, Cerro Atajo and Agua Tapada prospects (Allison, 1985; Suchomel, 1988). These complexes intruded alkaline (shoshonitic) andesites of the Farallón Negro volcanic group. The Farallón Negro intrusive-extrusive complex lies well east of, and is younger and more alkaline than, Cordilleran porphyry systems. These attributes support the “flat slab” concept of eastward migration of magmatic activity in Tertiary time (Ramos, 1995). Jones (1994) and Sass et al. (1995) documented extension in the Bajo de la Alumbra area.

**Bajo de la Alumbra** was discovered in 1949 and explored by YMAD. The deposit is the largest and richest in the Farallón Negro volcanic field. Mapping has defined at least four phases of porphyry and genetically zoned porphyry-style hydrothermal alteration. A central potassium silicate-magnetite-rich zone is overprinted by a phyllic-argillic phase comprising sericite, clay, and pyrite. The central zone contains 1 g/t Au and 1-2 g/t Ag as chalcopyrite. A zone of propylitic alteration zone peripheral to the potassic core mainly affects the host volcanic rocks (Jones, 1994). Bajo de la Alumbra contains a geologic resource of 753 Mnt containing 0.51% Cu and 0.65 g/t Au (Skilling Review, 1995). It is projected to start production in 1998.

Several age-equivalent gold- and copper-mineralized intrusive complexes are east of the Farallón Negro field, controlled by a N 80° W. structure visible at satellite scale: Cerro Atajo, a disseminated epithermal gold resource, and Agua Rica (Mi Vida), a Cu-Mo-Au porphyry deposit. The Agua Rica porphyry intrudes Paleozoic metasedimentary rocks 30 km east of Bajo de la Alumbra (Sasso et al., 1995). First described by the United Nations (1968), Agua Rica was optioned and explored by Cities Service during 1970-1972. They drilled almost 8,000 m of core to depths of 500 m. This drilling defined a copper-molybdenum resource of approximately 100 Mnt of 1% Cu equivalent. Exploration identified a multi-phase porphyry system in which a second event characterized by alunite-argilite-pyrite, overprints an early phase of hydrothermal alteration and mineralization (Koulakovskiy and Muré, 1976). Exploration since 1995 has greatly expanded size and grade of the Cu-Au-Mo resource, which may eventually surpass the resource at Bajo de la Alumbra.

**Farallón Negro and Alto de la Blenda** silver-manganese veins are peripheral to—and most likely genetically related to—the Bajo de la Alumbra porphyry. Both veins contain massive manganese oxide with accessory quartz, Mn-carbonate, and abundant silver sulfosalt minerals. The Japan International Cooperation Agency intensively explored the underground potential of the veins from 1988 to 1992. The current resource is 1.1 Mnt containing 6.4 g/t Au and 126 g/t Ag.

The Capillitas district contains five veins with complex metallurgy: pyrite, enargite, tennantite, chalcopyrite, chalcocite, gold, and silver with a...
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gangue of banded rhodochrosite-quartz, barite, and alunite. These veins contain about 5000 t of gem quality rhodochrosite, the highest quality source known in South America. Currently the precious metals cannot be extracted economically.

The Nevados de Pamantina range, La Rioja Province, hosts multiple vein systems (Pamantina, Figure 1) related to late Miocene-early Pliocene synerhythmic subvolcanic intrusions (Mogote Formation, 5-6 Ma). La Mejicana copper-gold vein prospect, mined since pre-Colombian times and by Jesuit monks, was developed underground by English companies in the early 1900s. An estimated 40,000 oz. of gold were extracted in historical times. The district is currently being explored for bulk-tonnage gold-copper deposits. La Mejicana and nearby copper and gold vein districts, Los Bayos and Ofir, contain quartz, alunite, enargite, bornite, chalcopyrite, and pyrite in sulfidized vein systems. The mineralizing event is dated at 3.8 Ma, and the alteration products are typical of a porphyry copper system (Losada-Calderón, 1990; Marcos et al., 1995). To the east, the Cerro Negro, Caldera, and Tigré silver-telluride-Pb-Zn districts contain low-sulfidation (adularia-sericite) styles of mineralization that include quartz, siderite, rhodochrosite, silver sulfosalt, telluride, arsenide, and Ni-Cu-Pb-Zn minerals, and widespread areas altered with potassium-silicate and biotite (Schulamuk and Logan, 1994).

Skarns related to Tertiary stocks are near the town of Guadalupe in San Juan. The Gualcamayo skarn deposit (650,000 t at 6 g/t Au) is in a block of Ordovician limestone that is a xenolith within Miocene tonalite at Guallán, stratagraphically gold is in Ordovician limestone near a faulted unconformity. At two such prospects, the principal skarn replacement deposits and breccia bodies host gold-bearing pyrite, sphalerite, and chalcopyrite next to Tertiary intrusions (Logan et al., 1991; Logan, 1992). The Urcusham prospect contains Fe-Mo-Au and minor Ag-Bi-Cu-W minerals in a scheelite-bearing skarn formed at the contact of a Miocene (?) tonalite stock with Ordovician limestone (Logan, 1992).

PRECORDILLERAN AND CORDILLERA DE DEPOSITS. Middle to late Tertiary copper and Cu-Au porphyry systems are emplaced along the PreCordillera and Andean Cordillera from Neuquén north to San Juan. El Pachón (9-10 Ma) is the largest known deposit in Argentina and is one of numerous young porphyry copper deposits (4-5 Ma) in the Andean Cordillera of Argentina and Chile. It adjoins the Los Pelambo porphyry copper deposit in Chile. There are several smaller prospects nearby, including Yungas and the Piuquetes gold-enriched porphyry copper occurrence. El Pachón has a resource of 890 Mmt at 0.61% Cu, including 186 Mmt with >1% Cu. The potentially economic resources at El Pachón are high-grade chalcopyrite blanket in the north and high-grade, late hydrothermal chalcopyrite (up to 1.5% Cu) that is the matrix of the breccia pipe in the south (Lencinas and Tonel, 1993). Logistical difficulties inherent in mining operations in the Argentine high Cordilleras have impeded development of El Pachón; however, this may be resolved in the near future through bilateral agreement with Chile that permits convenient access.

The Uspallata graben focused placement of copper-(gold) porphyry systems at Paramillos Norte and Sur, San Jorge II, Chita, and El Salado, and epithermal gold occurrences at Castañó Nuevo and Pampa Fria. Age of mineralization is not well documented at these deposits, but it is less than 12 Ma at Chita (Sillito, 1977). Supergene enrichment of primary chalcopyrite at Paramillos Sur and San Jorge II enhanced hypogene copper grades (0.3-0.5% Cu) to about 0.8-1% Cu. El Salado is a classically zoned, porphyry copper-gold system discovered in 1994, that is presently being drilled.

Color anomalies caused by hydrothermal alteration in Mendoza Province and south of El Teniente (Chile) indicate the presence of subvolcanic porphyry stocks such as Cerro Amarillo, where surface and geophysical exploration by Minera Aguilar in the 1970s defined a double-lobed, mineralized quartz dioresite porphyry with chalcopyrite ±0.4% Cu with anomalous gold credit (United Nations, 1970).

Campaña Mahuida, Neuquén, is the approximate southern limit of Tertiary porphyry copper occurrences. Exploration has defined a hydrothermally altered porphyry copper system emplaced in Jurassic sediments, and a resource of 4.7 Mmt of 0.7% oxide Cu and 23 Mmt of 0.6% sulfide Cu.

Patagonia Cordilleran volcanism continued into the mid-Tertiary from Neuquén south to southern Santa Cruz. At the Huemules project, Chubut, gold-silver-(Cu-Pb-Zn) veins cut out over a 3.5 km by 500 meter area. The metal-bearing veins are associated with Tertiary andesite and rhyolite intrusions in Cretaceous volcanic rocks. Stated reserves of 60,000 t of 8.3 g/t Au, 50 g/t Ag, 1.5% Zn, may have been augmented by recent drilling.

The Mina Angela Pb-Zn-Cu-Au-Au vein district, Chubut, is hosted by Jurassic andesitic rocks of the Semonkura Massif (Figure 3). The district contains shear-hosted veins and stockworks of chalcopyrite, galena, sphalerite, siderite, and adularia. The veins are spatially related to microdiorite stocks and rhyolite dikes, of probable Miocene age. Mina Angela operated until 1992, and has a remaining resource of 350,000 t of 3.5 g/t Au, 50 g/t Ag, 5.6% Zn, 2.9% Pb, and 0.38% Cu.

Middle to late Tertiary volcanism characteristic of the Andean and PreCordillera was extensive and episodic. It culminated in development of multiple, superimposed calderas and related epithermal Au-Au deposits (Janas et al., 1990; Davidson and Mpodozis, 1991). Large Chilean epithermal deposits provide models for what may be discovered just over the border in Argentina.

The El Indio belt in Chile hosts spectacular, gold-rich, acid sulfate systems developed over a 100 km north-striking belt. The systems are localized by NE, NW and NW faults. Discrete deposits and occurrences are exposed over 1000 m of relief, from uppermost quartz-alunite-native sulfur to enargite-pyrite-chalcopyrite at depth. The El Indio district produced 4.47 M oz of gold from 1979-1994 and contains proven and probable reserves of 8.8 M oz. gold. Within this district, precious metals are hosted in quartz-alunite hydrothermal breccia at Tambo, in bonanza Au-Au veins at El Indio, in quartz-alunite Mn-rich fissure veins at Río del Medio, and in auriferous enargite-bearing stockworks and replacement manto bodies within permeable tuff layers at Nevada (Siddeley and Areneda, 1990). Nevada is now known as the Pascua project and has an estimated resource 3.4 M oz. of gold.

In adjacent Argentina, deposits of epithermal mineralization include bonanza quartz-alunite-gold veins at Zancarrón; hydrothermal breccia at Río Frio; and a >1500 m vertical profile at Lama that exposes an enargite-pyrite root zone which grades upwards through a quartz-taolinite-pyrite zone to an upper alunite-native sulfur zone. All three occurrences are currently being
Eluvial placer deposits

Some Mongolian and Russian geologists consider eluvial material to have played an important role in the formation of alluvial and eluvial placer deposits where a residual or lag concentration of heavy minerals was subsequently moved into alluvial or eluvial environments by wind or torrential runoff. Eluvial placer deposits in southern Mongolia (Figure 2, nos. 24, 25) have residual mineral accumulations in and on weathered bedrock. These deposits typically contain semi-precious stone (garnet, chalcedony, agate, chrysoprase) and form by the weathering and disintegration of bedrock. Some deposits (Ih-Jargalant and Dalanjargalant, Figure 2, nos. 24 and 25) are the product of weathered volcanic rock that once had semi-precious stones such as agate and opal in cavities; these resistant minerals accumulate on the weathered bedrock surface. There is no soil cover, as soil and rock detritus are removed via aeolian erosion.

Ih-Jargalant is an eluvial-diluvial deposit of chalcedony and agate covering an area of 1.5 x 2 km. Quaternary sediments cover vuggy basalt of Upper Jurassic.
...from 13\textbf{ Placer Deposits of Mongolia, cont.}...

to Lower Cretaceous age. Mineral fragments are 3 to 12 cm in
diameter and the reserve estimate is 232 t of good quality
chalcedony and agate.

More eluvial placer deposits are likely to be discovered in the
future, as the succession of weathering and erosion events necessary
for eluvial placer genesis have taken place over geographically
widespread portions of Mongolia. There is evidence of relict
weathering crust in southern Mongolia, even though important
volumes of the older weathering crust have now been washed or
blown away.

\textbf{Glacial Placer Deposits}

Little information is available on glacial placer deposits in
Mongolia. These deposits might be found in Late Tertiary and
Quaternary glacial sediment in mountainous areas in the regions of
Altai, Khangai, Khentei, and Khubsugul mountains.

\textbf{Technogenic (man-made) Placer Deposits}

Gold is the only commodity recovered from man-made deposits
rich enough to mine. Mine spoil may be remined because low-
recovery processing techniques used in the past left fine gold which
can be economically recovered with current technology and gold
prices.

At the beginning of this century, the company Mongolor mined
and recovered about 10 t of gold from the Irogol technogenic placer
deposits (Figure 2, near no. 26) of the North Khentei district. During
1975 to 1980, the mine spoil of Mongolor was explored and found
to contain sufficient gold concentrations (up to 400 mg/m³) to justify
more reprocessing. In most cases, the deposit is at the surface with
gold-rich strata less than 10 m thick, but gold distribution is irregular
and grades are economically marginal (60 to 450 mg/m³). The
reserve of individual placer deposits such as in the Irogol district,
determined by surface sampling and wide-spaced drilling, averages
200 to 250 kg of gold. Another technogenic deposit in the Irogol
district is Ih-Azher (Figure 2, no. 26), where the spoil is 4 km long,
50 to 800 m wide, and up to 8 m thick. Gold grades generally range
from 70 to 220 mg/m³, and are as high as 600 mg/m³.

The technogenic placer At-Chuluut (Figure 2, no. 17) is the result of
underground mining of the original At-Chuluut gold placer to a
depth of 60 m from 1939 to 1953 when miners dumped low-grade
ore near the mine. Recently, the Bayankhongor-Geology public
company started exploring the mine waste by trenching. They found
gold grades of 400 to 600 mg/m³, low clay contents (< 3% clay), and
estimate the gold reserve to be nearly 100 kg.

\textbf{CONCLUSIONS}

Recent political changes in Mongolia and its reform toward a
market economy have piqued the attention of the West. Mongolia is
one of the most sparsely inhabited nations in the world with a
population of 2.2 million people and an average density of about
1.4 persons per square km. Despite the nomadic lifestyle of most of
its people, Mongolia has an active mining sector, and growth in
placer gold production over the past few years has sparked a
general interest in the geology of Mongolia and a particular interest
in its placer deposits.

\begin{center}
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\textbf{PAID ADVERTISEMENT}
The New Orleans GSA meeting provided the occasion for the Society of Economic Geologists to present four annual awards to recognize outstanding contributions to the Society and to the science of economic geology. Nominations for these awards are originated by Society members and directed through appropriate SEG committees responsible for verifying the qualifications of the nominees for the respective awards, and for selection of recommended candidates whose names are presented to the SEG Council for final approval. The citations and acceptances for each of the awardees will be published in a forthcoming issue of Economic Geology. For the Society's 75th anniversary year, those honored are:

**INOCREN AWARD**

**DR. JEREMY P. RICHARDS**
**LEICESTER UNIVERSITY**

**Citationist:**
Dr. Edward Spooner

---

**ALPH W. MARBSEN AWARD**

**DR. CLAY TAYLOR SMITH**
**NEW MEXICO TECH**

**Citationist:**
Dr. William X. Chávez, Jr.

---

**SEG SILVER MEDAL**

**DR. STEVEN D. SCOTT**
**UNIVERSITY OF TORONTO**

**Citationist:**
Dr. Jeffrey Fawcett

---

**ENROSE GOLD MEDAL**

**DR. HEINRICH D. HOLLAND**
**HARVARD UNIVERSITY**

**Citationist:**
Dr. Ulrich Petersen

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Third Biennial SGA Meeting and SEG Symposium

PRAGUE • AUGUST 1995

The Third Biennial SGA Meeting was convened under the auspices of the Minister of the Economy of the Czech Republic, Mr. Karel Dyba and the Minister of the Environment of the Czech Republic, Mr. Frantisek Benda. Sponsors included the above ministries, as well as the BRGM (France), The Charles University of Prague, The Czech Geological Survey, Greenwich Resources plc. (U.K.), The International Association on the Genesis of Ore Deposits (IAGOD), The International Geological Correlation Program (IGCP 357), RTZ Mining and Exploration Ltd. (U.K.), and the Society of Economic Geologists (SEG).

The SEG-sponsored symposium, "Mineralization in Black Shales," and the SEG-sponsored field trip to the Polish Kupferschiefer deposits, formed an integral part of the meeting. Keynote lectures at the SEG symposium were presented by Dr. Jane Plant of the British Geological Survey, and by Prof. Harry Kucha of the Academy of Mining and Metallurgy in Krakow, Poland, who also acted as leader for the SEG Kupferschiefer field trip. The SGA/SEG meeting in Prague was attended by about 400 participants from all continents; about one-third of them came from East European countries including Russia. More than 230 contributions were presented as lectures and as posters in three parallel sessions. The main topics addressed were:

- Metallogenesis in the Evolution of Orogenic Belts
- Gold and Precious Metal Deposits
- Submarine Hydrothermal Processes and Volcanic-Hosted Mineral Deposits
- Sediment-Hosted Mineral Deposits
- Vein and Shear Zone Deposits
- Granitoid-Related Deposits
- Deposits of Industrial Minerals
- Environmental Aspects of Mineral Deposits (in cooperation with RTZ Mining and Exploration Ltd., U.K.)
- Organics and Mineral Deposits (IGCP 357)
- Metamorphism and Mineralizations (IAGOD/WGIM)
- Mineralization in Black Shales (SEG: 15 contributions, no posters)
- Open Session

Content and scientific value of the contributions was generally good; however, in some sessions the selection of speakers, especially from East European countries, was slightly unbalanced.

The inclusion of environmental aspects has been praised by many participants, and it is considered an important step in the right direction resulting in a vast new spectrum of speakers and conference participants. Future meetings should consider this.

The four-day SEG field trip lead by Prof. Harry Kucha was considered a great success; there were participants from many European countries as well as from Australia, China, The United States and South Africa. (See companion article by R. Coweney.)

A separate field trip to the Erzgebirge was lead by K. Sellmann of Postdam and K. Breiter of Prague. This was also considered very successful with participants from four continents and a good guide book.

The SGA meeting took place at the Agricultural University, about 20 km from the Center of Prague. Although the meeting was “self-contained” with hotels, dormitories and restaurants available on campus, the distance and difficult connections with the Center of Prague did not facilitate sightseeing in one of Europe’s most beautiful cities.

The most impressive and lasting result of the SGA meeting is the superb hard-cover Conference Volume, containing four-page extended abstracts, with illustrations and tabulations, of more than 230 contributions (of one thousand and eighteen pages) elegantly produced by Balkema Publishers of Rotterdam entitled, "Mineral Deposits: From Their Origin to Their Environmental Impact" (ISBN 90 5410 550 X). The volume was edited by Jan Pasava, Bohdan Kribek and Karel Zak. The proceedings of the SEG symposium occupy a separate section in this volume (pp. 923-980). Copies are available from A.A. Balkema, Rotterdam (FAX: +31 10 413 5947) for US$105. Considering its size and scope, this book is a very good value and a must for every economic geologist.

The organizing Committee, and especially the Secretary General Jan Pasava, deserve the highest praise for a well-organized international meeting, which provided good science, ample East-West contacts, and some remarkable field trips. Thanks to the integration of the SEG Symposium and the SEG field trip, the meeting also provided an excellent example of SEG-SEG cooperation, an example which, we hope, will be emulated frequently in years to come.

— Contributed by E.F. Stumpf, Regional Vice President—Europe

ANNOUNCING AN SEG SHORT COURSE
APPLICATIONS OF MICROANALYTICAL TECHNIQUES TO UNDERSTANDING MINERALIZING PROCESSES
OCTOBER 26-27, 1996

GEOCHRONOLOGY AND RADIOGENIC ISOTOPES
- U-Pb Geochronology by Ion Microprobe: Not Just Ages But Histories
- Pb Isotopes using the Ion Microprobe
- 40Ar/39Ar Geochronology Using the Laser Microprobe

STABLE ISOTOPES
- S Isotopes by Ion Probe
- S Isotope Analyses Using the Laser Microprobe
- C and O Isotopic Analyses
- Ion Microprobe Analysis of O and H Isotope Ratios
- Laser Microanalysis of Silicates for 18O/16O and of carbonates for 13C/12C

ELEMENTAL ANALYSIS
- Trace Element Geochemistry with the Ion Microprobe
- Ion Probe Quantification of Precious Metals in Sulfide Minerals
- Micro-pixe
- Economic Applications of Accelerator Mass Spectrometry
- Major, Trace and Ultrace Element Analysis by Laser Ablation ICP-MS

FLUID INCLUSIONS
- Halogens and Noble Gas Isotopes in Fluid Inclusions
- The Laser Raman Microprobe as a Tool for the Economic Geologist
- Synchrotron-source X-ray Fluorescence Microprobe: Analysis of Fluid Inclusions

The course will be held immediately before the SSA Annual Meeting in Denver, Colorado. For information, contact Michael A. Mckibben at Tel. (909) 787-3444, Fax (909) 787-4324, or e-mail: michael.mckibben@ucr.edu.
In August, 1995, Henryk (Harry) Kucha and Adam Piestrzyński of
the University of Mining and Metallurgy, Krakow,
led 23 visitors on a field trip to examine Cu-Ag deposits associated with
the Permian Kupferschiefer
in Silesia, western Poland.
Sponsored by SEG and the Society of Geology Applied
to Mineral Deposits (SGA),
the trip originated and ended in Prague, and
attracted participants from
Australia, Austria, Canada,
England, France, Germany,
Italy, New Zealand, Poland,
Russia, Switzerland,
and the United States. The group traveled by bus to Lubin,
northwest of Wroclaw, to examine the Cu mines of the Lubin-
Sieroszowice mining district, underlying an area amounting to ~600
sq km. (This and other statistics given herein are taken mainly from
field notes supplied by Drs. Kucha and Piestrzyński.)

Annual production from the Lubin, Polkowice, Rudna, and
Sieroszowice mines totals ~400,000 t of Cu, 1000 t Ag, and 0.4 t Au
and is derived essentially from a single ore body ranging up to 26 m
in thickness. Grades average ~2% Cu and 40 ppm Ag. The district
should ultimately yield ~70 x 10^6 tonnes Cu and 170,000 tonnes Ag.

With two full-days on site, participants saw the ore-processing
plant, the tailings pond (see photo), and two underground mines, as
well as cultural attractions in Lubin, nearby Legnica, and at the
Czech-Polish border. Harry Kucha guided the group at the Polkowice
Mine which was opened in 1968 to exploit an ~850 m-deep,
nearly flat-lying 84 sq km mineralized zone, at an
annual rate of 17 Mt of ore. Both the Kupferschiefer
and the overlying Zechstein sequence are heavily
mineralized. Like the adjacent
Lubin Mine from which Kucha first
described precious metal
mineralization (Economic
1578), the Polkowice Mine
contains Au, Pt, and Pd
values. Kucha stressed
the association of these
precious metals with the
hematitic Rote Faule alteration
zone which he
interprets to be of complex
origin, only partly coeval with deposition of Cu ore.

Adam Piestrzyński led the group at the 800-1100 m-deep Rudna
Mine from which 3000+ underground employees annually produce
~10.5 Mt of ore from the Kupferschiefer and enclosing strata. The
very thin (~0.5 m) Kupferschiefer is well-exposed in most of the
mine, but pinches out over highs in the underlying Weisseelegendes
which contains the district's richest Cu ore; this ore is characterized,
in part, by spectacular chalcolitic liesegang banding.

The trip was run under the auspices of the biennial SGA
meeting, organized by Jan Pasava and Bobdan Kribee of the Czech
Geological Survey, and complemented an SEG session on mineraliza-
tion in black shales set up by SEG Regional Vice President Eugen
Stumpl and Henryk Kucha. Many thanks to all for arranging a great
trip!

—Contributed by R.M. Coveyey Jr.
Forty participants from the Mineral Deposits Division of the Geological Association of Canada and the Society of Economic Geologists returned from this memorable trip marveling at the immensity of South Africa's great ore deposits. The fascination of their geology, the warmth of their hosts' hospitality and the beauty and diversity of this country. We experienced all this as we traveled; from the low veld in northeastern Transvaal up the Drakensburg, through the high veld of western Transvaal and northern Cape, and onward across Kalahari to barren Namaqua and the coast at Oranjemund; through urban Johannesburg via Kimberley, Uppington, Pofadder, and on to magnificent Cape Town.

Des Pretorius, Carl Anhaeusser, Spike McCarthy, Morris Viljoen and Rudy Boer welcomed us at the University of the Witwatersrand with a "warm-em-up breif," overview talks on South Africa's gold mining history, and discussions of regional geology and deposits to be seen during the following week. Grant Cawthorn then led us north via the Magaliesburg Ridge and across the "flats" underlain by the lower layered strata of the Bushveld Igneous Complex to Rustenburg.

The week began with an underground visit to the Merensky and Ug-2 platinum "reefs" at Anglo American Platinum's Rustenburg Mine, where we experienced a new use for North American poma lifts and nobody fell off! We visited the magnificent Union Buildings in Pretoria on our way back to Johannesburg. A Tuesday surface traverse with Spike McCarthy took us across the 2,900-2,700 Ma Witwatersrand succession in Johannesburg. This was followed by an underground look at deep mining of Elsburg conglomerate reefs at JCI Ltd.'s Cooke #3 and Western Deeps shafts, and by a fascinating visit to their new open cast operations on the basal Black Reef of the Transvaal Supergroup at L intimid. Morris Viljoen led a Thursday regional surface transect across the Bushveld Igneous Complex from its granophyric roof rocks, through the V-magnetite seams of its Upper Zone in the former Lebowa Homeland, and the intricately complex Ug-1 seams at Dwars River to Palabora. He accompanied us underground on Friday to see JCI's stibnite-gold ores in the ca. 29 Ga Archean Murchison greenstone belt, and to a final, late stop at a pegmatitic emerald occurrence.

The weekend saw us viewing game in Kruger Park; apart from a magnificent herd of Cape Buffalo, and a couple of grey humps in the distance that might have been elephants, we didn't do well on the "big five" (buffalo, elephant, lion, leopard and rhino) due mainly to a rainy afternoon. It was then back to Johannesburg for a flight to Limpopo.

On Monday we toured that historic town, peered into its "Big Hole," then headed for a look at Finsch Mine and Kimberlitenik dykes that cut stratomagmatic dolomites of the Transvaal Supergroup in the nearby Lime Acres Quarry. We overnighted at charming Kuruman and were overwhelmed next day by 15 BILLION tonnes of 38% Mn ore in the Kalahari Manganese Field. A long drive to Uppington put us in reach of Gold Fields' highly metamorphosed, large Pb-Zn-Cu-Ag "sedex" deposits at Black Mountain-Aggenys. We continued to Springbok and its historic old O'okiep Copper District in northwestern Cape Province. Underground faces of chalcopyrite-borneite ores at Carolusberg and Nigranoep Mines, and a surface look at one of the "stEEP structures" that host the sulfides, left us thoroughly bewildered about the genesis of these truly enigmatic ores (the only other known similar example being that at Carniha in Bahia, Brazil—which incidentally does NOT "fit" to O'okiep across the "opened" Atlantic). The final geological highlight was an unforgettable visit to NAMDEB's alluvial diamond operations north of Oranjemund, Namibia. Here we came to appreciate the stringent security measures (even the writer's hand lenses were separately X-rayed) after watching vacuum-suction machines inhale diamonddiferous gravels from pre-stripped bedrock surface!

A flight late Friday took us to Cape Town where Faculty of the University of Cape Town hosted the group next morning at Rendebosh. Sessions included talks by Lawrie Minter and John Gurney. Dr. Minter effectively dispelled the insidious and strangely recurrent CNAH (Creeping North American Hydrothermalist) Syndrome that infects overseas visitors to the Witwatersrand, and Dr. Gurney convinced us all that from Archean to (and at) the Present, diamonds are forever! Our hosts at UCT sent us off with a delicious, SEG-sponsored luncheon following the morning's discussions. A cabeway trip up Table Mountain was impossible owing to Antarctic winds, but its Tablecloth WAS visible; we toured Cape Town's Waterfront, its downtown and restaurants, sampled the Cape's wines and sea foods, and circled the Cape Peninsula.

No one explained however, why and how come South Africa should have the world's largest platinum, chrome, vanadium, gold,
manganese, antimony and alluvial diamond deposits, as well as some of its most unique ones as at Palabora and O’okiep.

Our heartfelt thanks go, not only to those named above, but to the many university and mine geologists, their institutions and companies, who so warmly hosted us, so efficiently organized the visits of 40 “foreign invaders,” and made our visit to their country so truly memorable. The monumental efforts of Dani Alldrick of the Geological Survey Branch of the British Columbia Ministry of Energy, Mines and Petroleum Resources in Victoria, in arranging all air and road travel, accommodations, meals, and mine, university and surface visits, as well as his imperturbability over the inevitable unforeseen “glitches,” allowed everything to go as planned with minimal disruption. Thanks, Dani, from us all, for a superb job, well done.

—Contributed by Richard W. Hutchinson
(Editor’s Note—Alldrick, et al will provide a more detailed description of the technical aspects of the trip in the next issue of the Newsletter.)

Thayer Lindsley Visiting Lecturers

FOR ACADEMIC YEAR 1996-97

The Society of Economic Geologists announces the appointment of Dr. Richard W. Henley and Dr. Lawrence D. Meintert as the Thayer Lindsley Visiting Lecturers for 1996-97. Dr. Henley is CEO of Etheridge Henley Williams Geoscience Consulting Group, Canberra, Australia, is a Fellow of SEG, and has worked in both industry and academia. Dr. Meintert is Professor of Geology at Washington State University, Pullman, WA, a Fellow of SEG, and an internationally known consultant specializing in skarn deposits. This year, Dr. Meintert will be lecturing in the U.S., Canada and perhaps Mexico, whereas Dr. Henley will lecture in Australia and the South Pacific. Academic institutions interested in applying for a Thayer Lindsley Lecturer should note these circumstances.

Dr. Henley began his career in academia, moved to government and finally chose the consulting field for his profession. He received his BSc degree with honors from the University of London and moved to Manchester for his PhD. His dissertation was one of the first modern studies of high temperature hydrothermal gold transport and also resulted in the recognition of large scale hydrothermal systems and their role in ore genesis especially in Archean shear-zone deposits. Upon completion of his Ph.D., he became a lecturer in Economic Geology at the University of Otago, New Zealand, later moving to the University of Newfoundland. His principal areas of research were in metamorphic fluid generation and flow, magmatic vapour plumes in porphyry copper systems, and alteration in volcanogenic massive sulfide deposits. In 1978 he joined the New Zealand DSIR specializing in geothermal exploration and development, and in 1986, he joined the Bureau of Mineral Resources in Canberra as Chief of Division in the Bureau. He left the Bureau in 1988 to develop a consulting practice which is now the largest in Australia. In addition to specializing in strategic and corporate management, he continues to advise as a geologist directly in exploration programs. He offers a single title which can be adapted to widely varying audiences: “Exploration in a chaotic world.” The chaos he envisions includes not only the extremely variable geochanical and geodynamic crustal settings of deposits, but also the complexities of the financial and political world. He also challenges some of the established paradigms and models such as the application of equilibrium concepts to ore genesis research and the understanding of a number of giant gold deposits. He is willing to offer informal seminars on some of his scientific specialties at the institutions he will visit. In answer to the question, “Why did he become a geologist?” he notes an early fascination with natural systems and a desire to see the world. For him it has certainly worked out well.

Dr. Meintert received a bachelor’s degree from Carleton College in 1975 and completed his Ph.D. at Stanford in 1980. After joining the faculty at Washington State, he continued his interest in skarn deposits and is acknowledged as one of the premier researchers in this area. His principal interests lie in magmatic hydrothermal systems and resultant fluid interaction with a variety of host rocks to form skarn deposits. He has worked on deposits ranging from the type skarn locality in central Bergslagen, Sweden where skarns formed during Proterozoic regional metamorphism, to very young magmatic systems in the South Pacific where the rocks are still warm and the “smoking gun” is still smoking! He has served on the editorial board of Economic Geology and regularly acts as a reviewer for other major journals and granting agencies. He has received several awards as an outstanding teacher and his lectures are widely known as being easy to understand and beautifully illustrated with photographs from his world travels. He has been involved with exploration from the grass roots level through discovery and final production. He plans to offer two talks, the first is adapted to a broad audience, including those with a limited geologic background, and the second for undergraduate and graduate geology students with a more detailed interest in economic geology. The titles are: (1) “Exploration geology on the frontier — the search for gold in exotic places” and (2) “Hydrothermal fluid flow and mineral zonation in skarns associated with magmatic systems.” He will need a screen and a single slide projector as he will be bringing his slides in a Kodak carousel tray.

Collegiate institutions offering degrees in geology are eligible to request a Thayer Lindsley lecturer to visit their campus. The Society of Economic Geologists Foundation provides funds for the lecturers and the only cost to institutions hosting the visitor is for local transportation and/or special activities such as receptions or local dinners. Dr. Meintert will visit three of four schools during the fall semester, 1996, and another three or four schools in the spring of 1997. Dr. Henley will probably make all of his visits during the latter part of either the academic year of 1996 or 1997 in the southern hemisphere (July or August through October or November, 1996 or ‘97) depending upon his consulting schedule. Requests are processed in order of receipt and priority is given to institutions who have never had a lecturer or to those who have not had a visit within the last two or three years.

Inquiries and/or requests for Dr. Meintert’s tour should be addressed to:

DR. CLAY T. SMITH
Secretary, Thayer Lindsley Visiting Lecturer Committee
Department of Earth and Environmental Science
New Mexico Institute of Mining and Technology
Campus Station • Socorro, New Mexico 87801
Phone (505) 835-5673 • FAX (505) 835-6436

Inquiries and/or requests for Dr. Henley’s tour should be addressed to:

DR. RICHARD W. HENLEY
P.O. Box 250
Deakin West ACT 2600, Australia
Phone 61-6-285-2402
FAX 61-6-285-2586
The Lindgren Award is offered annually to a young scientist whose published research represents an outstanding contribution to economic geology. The award consists of a citation, dues-free membership in the Society, and travel expenses for the award presentation, and is not restricted by a candidate’s nationality, place of employment, or membership in the Society. The award is given for research contributions to economic geology from any sub-discipline of geology (including, among others, structural geology, mineralogy, environmental geology, hydrology, petrology, geochemistry, stratigraphy, geophysics, and mine geology) published before the author’s 35th birthday. The awardee must be less than 37 years of age on January 1 of the year in which the award is presented.

Any Society member in good standing may nominate candidates for the award. We currently seek nominations for the 1996 Award, for which nominees must have been born after January 1, 1959. Nominees who are not selected in 1996, but are still eligible, will be considered for awards in following years.

How to Nominate

The following information should be submitted to the Chair of the Lindgren Award Committee by the person making the nomination no later than February 28, 1996:

1. Name of nominee.
2. Date of birth.
3. Education (degrees, institutions, dates) and previous awards.
4. Past and present professional affiliations.
5. Reference: citation(s) to publication(s) for which the award is to be made, and to other published works. Indicate critical paper(s) and provide a copy of the abstract, if possible. An individual’s contribution in co-authored papers is difficult to evaluate; such papers should be avoided unless the nominee is a senior author whose contributions can be clearly identified.
6. Brief statement explaining the significance of the research, including its pertinence to economic geology, its demonstrated effects, the originality and creativity shown in the research, the clarity of presentation, and its impact on scientific theory or technology.
7. Additional pertinent or related scientific contributions such as other accomplishments, advisory or consultant activities, and recognition of research stature elsewhere by others.
8. Names of individual making the nomination.

Supporting letters are helpful and may be attached to the letter of nomination or sent separately to the Chair of the Lindgren Award Committee:

Erich U. Petersen, Chair of the Lindgren Award Committee
Department of Geology & Geophysics
The University of Utah • 717 W. C. Browning Building
Salt Lake City, UT 84112-1185
Phone: (801) 581-7238, Fax: (801) 581-7237
E-mail: eupeters@mines.utah.edu • http://www.eg.utah.edu

SEG/SME Programming
SME Annual Meeting
Phoenix, Arizona, March 11–14, 1996
SEF and SME’s Mining and Exploration Division have organized what appears to be an exceptional technical program, comprising five technical sessions and a panel discussion, for the forthcoming 1996 SME Annual Meeting in Phoenix, Arizona. Following is a brief summary of the program.

Monday, March 11. “Mineral Exploration—Current Perspectives.” Domenico Politi, BHP Minerals, is the convener of this session comprising ten papers covering research and exploration for precious metals and diamonds in West Africa, and gold, Ni-Co and fluorspar deposits in Ghana, Tanzania and Namibia.

Tuesday, March 12. “Applying Economic Geology to Environmental Aspects of Mining.” This morning session is chaired by I. Walder and G. Plumlee and includes six papers addressing the participation of economic geologists in environmental issues involving mineral resources development, compliance, waste disposal, groundwater quality, and mine closure.

Following immediately at 10:30 am, Dr. Anthony J. Maddox will present the 1996 SEG Distinguished Lecture, “Critical Factors in the Formation of Magmatic Ni-Cu Sulfide Deposits as Illustrated by Those at Noril’sk, Sudbury, Jinchuan, and Kambalda.”

Tuesday afternoon, Debra Strohsacker will moderate a panel discussion involving mineral industry public relations issues and legislative lobbying efforts. Representatives from industry and federal and state government will participate.

Wednesday, March 13. “I. The Role of Science and Technology in Exploration and Discovery,” a morning session, is being chaired by G. Wessel and L.W. Freeman. Six papers covering the application of research and new technologies to exploration will be presented by recognized experts. Wednesday afternoon is a general economic geology session chaired by S. More and H.L. Stensrud. The session includes seven papers covering precious metals deposits in West Africa, the western U.S., and Chile, and one paper on Tertiary manganese deposits in Arizona.

Thursday, March 14. This general economic geology session, chaired by P. Fuhry and H.L. Stensrud, includes seven papers presenting deposit descriptions, deposit models, metallogenetic analyses, an exploration case history and geological and geophysical prospecting methods.

Editors’ note — See p. 15 of the October Newsletter for information on the SEG field trips and short course. The complete program listing individual papers appears on p. 46-48 of the “SME Annual Meeting & Exhibit” supplement to Mining Engineering.

Chrysalis Scholarship
The Association for Women Geoscientists has announced that at least two Chrysalis Scholarships of $750 each will be awarded on March 31, 1996, to women who have returned to school after an interruption in their education for one year or longer. The awards will be given to geoscience Master's or Ph.D. candidates to cover expenses associated with finishing their thesis. Applications should be submitted by February 28, 1996. For further information or to apply for a scholarship, contact:

Chrysalis Scholarship — Association for Women Geoscientists
G & H Production Co. • 518 17th Street, Suite 930
Denver, CO 80202 • Tel: (303) 534-0708
The Lennard Shelf is one of the few carbonate-hosted Zn-Pb provinces where the timing of mineralization and fluid sources are constrained. Controls on deposit location have been documented. The area is currently the subject of research programs by the Geological Survey of Western Australia, Curtin University, the University of Melbourne and the University of Western Australia. Research topics cover stratigraphy, facies analysis, cement stratigraphy, regional and local structural geology, geochemistry, ore petrography and ore deposit modelling. The field conference will provide participants with updates on the latest research with excellent opportunities to visit the Great Devonian Barrier Reef and to view the deposits at Blendeval, Cadgebaut and Twelve Mile Bore. The trip is organized by Julian Vearncombe (Vearncombe and Associates Pty Ltd) assisted by Simon Doering (UWA), Craig Gwathin (Western Metals NL), and Phil Playford (Geological Survey of Western Australia).

The 8-day field conference will start and end in Derby, Western Australia and will comprise one night in the hotel at Derby and the following nights camping out. The cost will be US$1,450 which covers the hotel in Derby, meals, camping costs and all travel during the 8-day conference.

A field guide has been published by SEG: Vearncombe, et al., 1995, Field Guide to the Zinc-Lead Mineralization on the Southeast Lennard Shelf, Canning Basin, Western Australia: Society of Economic Geologists, Guidebook Series, Volume 23; 218 pp, 4 coloured plates. Each participant will receive a copy of the Guidebook, the cost of which is included in the registration fee. (For those not participating, the Guidebook is available from the SEG office in Littleton, Colorado. Please see order form on page 43 of this issue.)

Immediately after the field excursion, Dennis Arne of Ballarat College of Advanced Education is presenting a two-day workshop on “Fluid flow in sedimentary basins with implications for base metal mineralization.” (See announcement in the Calendar section of this issue.) This workshop will be followed by informal field visits to look at the Ballarat-Bendigo greywacke-hosted goldfield. Guest speaker at the Ballarat workshop will be Grant Garven. These events are organized cooperatively, but separately. If interested, contact D. Arne on DCA@ts3.ballarat.edu.au.

For more information on the field conference, contact Julian Vearncombe at e-mail: vearncom@inet.net.au; Fax +61-9-335-1845. E-mail is the preferred mode of communication.
Ratified twenty-two actions taken by the SEG Executive Committee during the period March 7, 1995 – November 5, 1995 as follows:

- Accepted a recommendation to proceed with an investigation of the procedures and costs to move SEG's place of incorporation from the state of New York to the state of Colorado, utilizing the law firm of Davis, Graham and Stubbs in Denver, at an estimated cost of about $400.
- Unanimously agreed to recommend to the SEG Council that the Society Bylaws be amended to eliminate the "65/25" provision for Senior Fellow status in the Society.
- Ratified the appointments by President Skinner of Frederick M. Beck and Bruce A. Bouley to fill two open positions on the Finance Committee.
- Selected Theo Van Leeuwen of Indonesia and Antonio Arribas, Sr. of Spain to respectively fill the Regional Vice President positions for Asia and Europe, with terms of office beginning April 1, 1996, and subject to their willingness to serve.
- Approved a recommendation to investigate the possibility of forming an alliance or other type of association with the Society for Resource Geology of Japan, and requested that the Vice President for Regional Affairs prepare a recommendation in that regard for consideration at the Executive Committee meeting in New Orleans.
- (a.) Unanimously reaffirmed that the Society will not pay honoraria to organizer/presenters of Society Short Courses, but will reimburse the organizer/presenters for all reasonable costs incurred in giving such short courses. (b.) Authorized the Executive Secretary to open discussions with SME whereby a new normal payment by SME to its short course organizers/presenters by diverted to the shared revenue stream for those jointly sponsored SME-SEG short courses given by SEG organizers/presenters.
- Declined a request to provide $3000 in funding to (partially) underwrite the cost to relocate the "Ransom Collection of Ore Samples and Host Rocks" from Caltech to the Colorado School of Mines and re-establish the collection there.
- Declined a request to provide funding to (partially) underwrite the cost of "The James Hall Meeting, 2nd International Symposium on the Silurian System," to be held August 4-9, 1996 in Rochester, New York.
- Agreed to be a "supporting organization" for the "Mesozoic '96 Conference" to be held September 23-26, 1996 in Brisbane, Australia. (The program has a significant economic geology component and does not involve a financial commitment from SEG.)
- Approved the candidates recommended by President-Elect Nielsen for the Nominating Committee and the Committee on Committees, with the provision that Ross Large (Univ. of Tasmania) be added to the Nominating Committee and John F.H. Thompson (UBC/MDRU, Vancouver, B.C.) be added to the Committee on Committees, subject to their willingness to serve.
- Accepted the voting of the International Exchange Lectureship Committee to select Uhrich Petersen as the International Exchange Lecturer for 1996, and Tommy B. Thompson as the alternate.
- Approved the candidates (3 total) comprising Fellowship Lists 46 and 47.
- Selected Anthony J. Naldrett as the Distinguished Lecturer for the Society for 1996, from the candidates recommended by the Distinguished Lecturer Committee, the lecture is to be presented at the 1996 SME Annual Meeting in Phoenix.
- Selected Lawrence D. Meinert as a Thayer Lindsey Visiting Lecturer for 1996-1997, to replace Robert O. Rye who found it necessary to withdraw.
- Reviewed the report of the ad hoc "Visiting Committee" and unanimously accepted the following recommendations of that Committee:
  - That the position of Executive Secretary be upgraded to Executive Director, and that the Society Bylaws be amended to reflect this change, with the change in title to take immediate effect.
  - That the Executive Secretary/Director be allowed to expend funds without specific authorization up to an amount equal to 7.5 percent of the total budget for the SEG office.
  - That any of the three organizations (SEG, SEGF, PUBCO) requesting information and/or services to be provided by the SEG office staff, submit such requests in writing through the Executive Secretary/Director.
- Accepted the Treasurer's recommendation to maintain Society Annual Dues for 1997 at the 1996 level (US$75 per year).
- Approved a mutual lending-borrowing agreement with PUBCO.
- Approved Fellowship Lists 48, 49, and 50; seven candidates total.
- Approved the nomination of Jeffrey W. Hedenquist and Hugo T. Dummett as Thayer Lindsey lecturers for 1997-1998, with Mark D. Hannington and Tommy B. Thompson as respective first alternates.
- Endorsed President Skinner's response to Heikki Papunen, who will organize the biennial SGA meeting to be held in August, 1997 at Turku, Finland, that SEG will be pleased to join as a co-sponsor and that SEG's Regional Vice President-Europe will act as the SEG representative to the SGA organizing committee.
- Authorized President Skinner and Executive Secretary Thoms to advise SEGF President Barber that without a current proposal and budget estimate, SEG is not in a position to make a recommendation regarding the Foundation's video production project.
- Accepted Treasurer Loucks' recommendation to investigate the establishment of an SEG Foundation branch in Canada, and that...
the Foundation appoint a Canadian-based individual (preferably in Toronto or Ottawa) to pursue this in Canada.

- Accepted the Treasurer's report summarizing the financial status for each of the three entities—SEG, SEGFP and PUBCO—for the period January 1-September 30, 1995, and the report of the Finance Committee (presented by the Treasurer).
- Accepted the report of the Publications Committee and authorized an advance in the amount of $2000 for preparation of the proceedings volume for the St. Louis Conference.
- Accepted the proposal for a short course on "Applications of Microanalytical Techniques to Understanding Mineralizing Processes," to be presented in conjunction with the GSA meeting in Denver, 1996 and authorized an advance in the amount of $8000 for preliminary expenses.
- In response to a proposal submitted to the Research Committee to establish an SEG program to provide and distribute funds for graduate student research grants in economic geology, approved the appointment of an SEG ad hoc committee to investigate how such a program might be incorporated in the McKinstry research grant program administered by the SEG Foundation, and to submit appropriate recommendations at the next Council meeting.
- Accepted the report of the Program Policy Committee, but denied a request to provide the amount of $1500 for travel expenses for (US-based) speakers invited to participate in a joint SME-SEG panel discussion to be held at the 1996 SME Annual Meeting March 12, 1996 in Phoenix, Arizona.
- Elected A.J. Erickson, L.B. Gustafson and R. Newell trustees for the SEG Foundation, with terms ending in the year 2001. (According to the SEGF Certificate of Incorporation, "The membership ... shall consist ... of those persons who are then members of the Council of the Society of Economic Geologists ..."

- Voted to hold the 1996 Annual Meeting of the Society in Denver, Colorado, in conjunction with the Annual Meeting of the Geological Society of America, October 28-31, 1996.
Industrial (Non-Metallic) Minerals—Relatively Unheralded Economic Materials

by HAYDN H. MURRAY

DEPT. OF GEOLOGICAL SCIENCES • INDIANA UNIVERSITY • BLOOMINGTON, IN 47405

[Editors' Note—As mentioned in the October Newsletter, beginning with this issue Dr. Haydn H. Murray, an internationally known authority on industrial minerals, will be providing regular coverage on non-metallic mineral resources. The following article is the first in a series of four and will set the stage for those to follow. We are delighted to have Dr. Murray as a regular contributor to the Newsletter.]

Industrial minerals are essential to the economic well-being of any country and particularly so for the United States. According to the U.S. Bureau of Mines, the value of raw materials produced in 1994 in the U.S. was $34 billion. Of that amount, $23 billion is credited to industrial minerals and $11 billion to metallic minerals. These figures demonstrate the importance of industrial minerals in the U.S. economy.

A precise definition of industrial minerals, or non-metallic minerals, is difficult because they include many unrelated minerals that range from low-priced materials, such as sand and gravel, to very high-priced materials such as industrial diamonds at several million dollars per ton. The definition in the Glossary of Geologic Terms is, "any rock, mineral or other naturally occurring substance of economic value, exclusive of metallic ores, mineral fuels and gemstones; one of the non-metallics." The terms non-metallic and industrial minerals are synonymous; but in recent years the term industrial minerals has become the more popular one.

The standard of living in a particular country or area of the world correlates with the availability and production of industrial minerals. A measure of industrial maturity is achieved when the value of industrial minerals and rocks exceeds that of metallic minerals. That point was reached in the United States early in this century. Europe reached it in the period just prior to World War I, and Australia reached it in 1982. The U.S., which has one of the highest standards of living in the world, has ample supply of most industrial minerals and rocks. Without their availability at a reasonable price, the U.S. could not have achieved its high standard of living nor its tremendous industrial growth.

CLASSIFICATION

Industrial minerals and rocks are difficult to classify. In addition to the great diversity in economic values for industrial minerals, there is also great diversity in their geologic occurrences and in their utilization. It is impossible to pigeonhole many industrial minerals and rocks because they are used in a diversity of industries and, in many cases, for entirely different reasons. I prefer to classify industrial minerals into three economic groups: 1) low-priced, large volume commodities such as sand, gravel and construction materials; 2) medium to high-priced, large volume commodities such as kaolin and also chemical and fertilizer minerals as sulfur, phosphate and potash; and 3) high-priced, small volume commodities such as talc, feldspar and industrial diamonds.

A very simple form of classification is to categorize industrial minerals and rocks as either 1) chemical minerals or 2) physical minerals (Kline, Mining Journal 310:756B:354-355, 1988). For example, sulfur is a chemical raw material used for its elemental chemical value. Kaolin is a physical raw material used for the physical properties it imparts to paper, ceramics, paint and other applications; it is not changed in composition by the user.

INDUSTRIAL UTILIZATION AND VALUES

Industrial minerals are an integral and functional part of many products such as cement, ceramics, paper, paint, plastics, rubber, catalysts and a host of others, including those used in the building and processing industries. They are generally grouped by uses as follows:

- Abrasives
- Ceramic raw materials
- Chemical industry
- Construction materials
- Electronic and optical uses
- Fertilizer minerals
- Fillers, filters and absorbents
- Fluxes
- Foundry sands
- Glass raw materials
- Mineral pigments
- Refractories
- Well drilling fluids

Many individual industrial minerals are utilized in different applications. For example, kaolin is used in abrasives (calcined kaolin), ceramics, chemicals, electronics, fillers, foundry, mineral pigments and refractories.

The mining and production of industrial minerals is a growth industry which is not cyclic as are many of the metallic minerals. In 1994 the industrial minerals industry averaged an 11% increase in revenues over 1993; production tonnage increased 3% and profits were up 30% (U.S. Bureau of Mines Mineral Commodity Summaries, 1995). Geographically, metal mining and production is based almost entirely in the western United States, whereas industrial minerals mining and production is spread throughout the United States.

The location of the low-priced, high-volume industrial minerals such as sand, gravel and aggregates is exceedingly critical with respect to markets. In general, the transportation cost of these low-priced industrial minerals controls their marketability because the transportation cost commonly exceeds the FOB price of the mineral or rock. Thus, the mines for these minerals must be located as close to markets as possible. The urban growth around every major city has limited the expansion of operating mines and prohibited the opening of new mines because of zoning restrictions. As a consequence, the delivered cost has increased significantly in most major cities because of the increased cost of transportation. Policy development with regard to construction materials such as sand, gravel and aggregates should recognize the necessity of having a viable source for these materials and the need to locate and protect these essential resources for the future.

The medium to high-priced, large volume commodities are much less sensitive to the cost of transportation, although it is a marketing factor. The high cost of transportation gives considerable incentive to explore and locate resources nearer to markets. Lower quality materials located closer to markets may be produced profitably because lower transportation costs offset the cost of additional processing to bring the material to market specifications. The low volume, high-value industrial minerals are generally not affected by transportation costs.

Many industries depend on industrial minerals; some examples follow. This brief account is by no means complete, but does indicate the diversity and functionality of certain important industrial minerals.

The building industry could not function without industrial minerals. Cement is made from industrial minerals that include...
limestone and shale which are pulverized, mixed together in specified proportions and heated to form the necessary reaction products that make cement. In buildings and roads, cement is mixed with aggregate which can be sand and gravel or a mineral aggregate such as limestone or trap rock (basalt). If a lightweight concrete is needed, then a lightweight aggregate such as floated shale is used. floated shale is formed by rapidly heating crushed shale particles to a temperature in which some volatiles in the shale are released at the same time the surface of the shale particle is melting. The volatiles form internal voids as they expand when trapped by the viscous glassy outer melted surface. When cooled, the shale particles are strong and light in weight. Other building materials use industrial minerals: wallboard is made from gypsum; bricks are made from clays and shales; dimension or building stones include limestone, marble, granite, and many other rocks; plaster uses cement and perlite, and tile uses kaolin, talc, wollastonite and other minerals.

Industrial minerals are necessary in the smelting of metallic ores. In making iron and steel, a high-calcium limestone flux is used to lower the melting point of the iron ore. In making metallic aluminum, the flux normally used is fluorite, another industrial mineral. In smelting copper, silica sand is used as a flux.

In drilling of oil wells, industrial minerals play a very important role. In order to successfully drill an oil well, drilling mud, which is produced from industrial minerals, must be used. It is pumped into the hole as it is being drilled, and is the medium to carry tons of rock cuttings up the hole to the surface. It also seals the hole by forming an impermeable layer on the wall of the hole thereby preventing the drilling fluid from escaping. The mud also cools and lubricates the drill bit. The major component of drilling mud is usually sodium bentonite. This material, when mixed with water, forms a product which is fluid when agitated or stirred, and is gel-like when allowed to set. This property is called thixotropy. When the mud is pumped down the hole through the drill pipe to the bit, it is fluid but viscous enough to carry the rock cuttings up the hole. If drilling stops for some reason, the mud becomes a gel which prevents the rock cuttings from settling to the bottom and binding the drill bit in place. A bound bit could very well twist off with the re-start of drilling. Sodium bentonite is naturally thixotropic and is an absolutely essential ingredient in drilling muds. In deep drilling to several thousands of feet, the pressures of fluids in the rock formation are very high, and if gas or oil under high pressure is encountered, the drilling mud could be blown out of the hole triggering dangerous fires. In order to prevent these blow-outs, a weighting material is used. Finely pulverized heavy material is mixed with the drilling mud to make it heavy enough to suppress bottom hole pressures and prevent blow outs. The most common weighting agent used in drilling muds is the industrial mineral barite.

Ceramic materials are used extensively and are made from industrial minerals. Fine china is made using kaolin, silica and feldspar in proper proportions. Pottery is made from clays and other industrial mineral ingredients. Refractories, for lining high temperature furnaces, use various refractive industrial minerals including kaolin, kyanite, dolomite, silica and chrome. Glass, which is classed as a ceramic material, is made from high silica sand or quartzite along with a flux such as soda ash. Think of the amount of glass used in homes, cars and office buildings. To sustain the glass manufacturing industry, large quantities of high quality silica sand must be available in various parts of the country.

Think also of the amount of paper used everyday in homes and offices. Paper is made from wood pulp but requires other ingredients, mainly industrial minerals, to give it certain needed properties including whiteness, printability, smoothness, and opacity (hiding power). Fillers include kaolin, calcium carbonate, silica flour, talc and titanium dioxide. For color printing, such as in National Geographic magazine, the paper must be coated, and this coating is normally kaolin and/or calcium carbonate along with a minor quantity of titanium dioxide. National Geographic magazine is about 35% by weight of the industrial mineral kaolin.

In the foundry industry, industrial minerals are essential in making the molds into which molten metal is poured. The engine block in an automobile is made by pouring hot gray iron into a mold which must be strong enough to hold the molten metal, porous enough to release the gases from the molten metal as it cools, and refractory enough so that it doesn't melt and contaminate the iron. Two industrial minerals, high silica sand (which is the major component) and bentonite, have the needed properties and are utilized extensively to make these molds.

Industrial mineral fillers are essential ingredients in many industrial products including paint, plastics, rubber and ink. These fillers are not inert, but perform a needed function. Fillers or extenders in paint make the paint film glossy or dull, washable and smooth, and give it covering power and body so that it doesn't drip or run. In plastics, mineral fillers improve the surface smoothness of the plastic, and make it less brittle and less vulnerable to infrared and ultra violet degradation. Some automobile bodies and many boat bodies are made of plastic and contain up to 40 percent mineral filler, usually calcium carbonate or kaolin. Without the mineral filler, the plastic would shatter like glass upon impact. In rubber, industrial mineral fillers are used to improve abrasion resistance, stiffen the rubber product, reduce elasticity and improve hardness. In ink, fillers are used to control viscosity and to improve covering power.

Industrial minerals are used in the production of sorptive materials. In machine shops where oil spills commonly occur or in service stations where motor oil is spilled on the floor, an absorptive clay is used to soak up the oil. This type of clay is commonly referred to as fuller's earth. Sorptive clays are also used in agriculture as a carrier for insecticides and pesticides. The largest use by far for sorptive clays is as cat litter; more than a million tons of this clay are used annually in the U.S. by cat owners.

There are numerous other uses for a variety of other industrial minerals. The aforementioned examples serve to illustrate the importance of industrial minerals in worldwide economic development.

In the next SEG Newsletter, I will discuss the geologic occurrences and the drilling and testing methods utilized for industrial minerals.

—HHM

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Maybe it is the unseasonably warm weather this fall—or the rocks are finally cooperating—or somebody is finally smart enough to begin to figure out the treasures they offer—or the political climate is right—or it is the romance of exploration and promises of future rewards. Probably some combination of all. Regardless, exploration and development activity is sustaining. The upbeat news continues from the far north!

Nixon Fock, the first major, primary hard rock gold mine in Alaska since 1947 when the AJ Mine did its last clean-up, had the first pour on October 22. Consolidated Nevada Goldfields is shaking out the bugs in this 60,000 oz. per year, very high grade, underground mine in central Alaska, near McGrath. As of November 1, the mill was averaging 91 tons per day and was working up to design capacity of 150 tons per day. Mineralization occurs in copper-gold bearing skarns and the company anticipates that on-going underground exploration drilling will significantly increase the diluted mineable reserve base of 117,197 tons grading 1.32 oz. gold per ton. Twenty five percent of the gold is recovered by a gravity circuit and a gold-copper flotation circuit collects concentrates that are shipped to the Koshka smelter in Japan.

At Fairbanks Gold’s Fort Knox property near Fairbanks, construction is underway. By late summer 550 contractors and 80 mine employees were working to bring this 350,000 oz. gold per year property into production by October, 1996.

Teck will join the long list of majors who have taken a shot at the Niblack VMS property on Prince of Wales Island in southeast Alaska. Teck has come to terms with Abacus to finance the exploration by purchasing shares of Abacus over the next three years. In return for their investment, Teck has the ability to earn a 51% interest in the project by completing a feasibility study and placing the property into commercial production. Teck will spend $375,000 in 1995 and a minimum of $2M in 1996 to drill 20,000 feet in the Dama and Lookout Zones. Abacus’s obligation to Barrick is now complete. Barrick retains a 1 to 3% sliding scale NSR. CIR also retains an underlying interest in the property. Abacus reported success in the 1995 drill campaign, with several deep (+600 ft) intercepts of the Dama Zone; the best reporting 34.5 ft of 8.8% Cu, 9.7% Zn, 0.014 oz Au, and 2.08 oz Ag. Drilling at the old Niblack mine intersected four sulfide horizons 600 feet down dip from the trench showing, the best of which runs 5.08% Cu, 4.01% Zn, 4.79 oz Ag, and 0.42 oz Au over 16 ft at a depth of 785 ft.

Meanwhile Teck quietly completed an exploration program in the Ambler District, looking for Devonian VMS deposits.

Cominco’s significant new discovery, the North Extension ore body, lies approximately a quarter-mile north of the main Red Dog deposit. This flat-lying deposit, approximately 1,200 by 1,500 feet, with thicknesses up to 610 feet in the central portion, contains at least 73 million tons of 14% zinc and 3% lead with a substantial tonnage of lower-grade mineralization. The deposit is near the surface with a stripping ratio of about 3-to-1. Cominco plans to spend $90M to undertake a 30-percent expansion of production at Red Dog following the discovery of this new orebody. At the increased production rate, Red Dog would process 3.5 million tons of ore annually to produce approximately 900,000 tons of zinc concentrate and 100,000 tons of lead concentrate. As Cominco expands its efforts at Red Dog, they are regrouping and centralizing their exploration efforts at Cominco American’s headquarters in Spokane, Washington. The Alaska exploration office will close December 31, and in the future Cominco will handle work in Alaska from Spokane.

Placer Dome US must have gotten some positive results from their metallurgical tests on Callista’s Donlin Creek gold property in western Alaska. They are gearing up for camp construction and plan to have five drill rigs turning in 1996. The rumors of opening an office are true, sort of. They have rented a warehouse near the airport with a desk and a phone. President Jay Taylor visited Alaska, met with key state representatives this year, and was a featured speaker at a session at the AMA convention this November.

Kenncott Exploration remains active in the Ambler District, in the Nome area at Rock Creek and other Bering Straits-owned properties, and are moving two of their Spokane-based geologists to Juneau. Kenncott continues to maintain their lease and plans a program in 1996 on the Palmer property in southeast Alaska, an extension of the Windy Craggy terrain, despite the inactivity on the property in 1995.

Newmont/La Teko have expanded the True North property in the Fairbanks district. RC and diamond drilling on 400-foot centers confirmed a continuous zone over 3,000 feet between the Hindenberg and Shepard zones, pushing this property to 7 million tons grading 0.065 oz. gold per ton. Intercepts ranged from 65 ft of 0.044 oz. gold per ton to 35 ft of 0.053 oz. gold per ton. Outcropping mineralization reportedly covers an area 1 mile x 0.5 miles, with mineralization open in all directions. Encouraged by the results, Newmont has commissioned two diamond drills, for 8,000 total feet, starting the first week of November.

Coeur Alaska Inc., the developer of the Kensington Mine, north of Juneau in southeast Alaska, embarked on an innovative solution to commit federal and state agencies to a timely review of permits. Coeur, EPA, and ADEC have signed a Memorandum of Understanding which sets out the process to analyze Coeur’s permit applications. The agreement sets a target date of December 15 for a draft discharge permit to be issued by EPA, and a goal of issuing the final permit by May 1. This may be optimistic in light of EPA’s recent request for updated and more complete information.

Coeur’s agreement with EPA gives them top priority, leaving Kenncott and Echo Bay further down on the list. With recent budget cuts to EPA, the agency’s ability to complete timely work on environmental permits needed for the reopening of the Greens Creek Mine and redevelopment of the AJ mine is in question. Despite this, Greens Creek will maintain an active exploration program on available lands on Admiralty Island.

Will ACNC drill in the Delta District next year or will they scale back? And what about the Hetta Inlet VMS property in southeast Alaska? Rumors of significant new discoveries have waxed and waned. Either these properties are best kept secrets or ACNC isn’t sure what they’ve got. But they are committed enough to Alaska to have their only US exploration office, staffed by six geologists, in Anchorage.

International Freegold Mineral Development was active on the Tolovana property in the Fairbanks district. Freegold is obligated to advance royalty payments of $300,000 over ten years with a $2.4 million purchase option until 1999, after which the price escalates to $3.9M by 2005. In addition, they must spend $300,000 on exploration.
The Neves Corvo Field Conference will be held at the Rectory of the University of Lisbon, Portugal, May 11-14, 1997, with pre- and post-meeting field trips. This is the first field conference outside of North America to be sponsored by the Society of Economic Geologists (SEG), and is co-sponsored by the Institution of Mining and Metallurgy (IMM), Society for Geology Applied to Mineral Deposits (SGA), Departamento de Geologia da Faculdade de Ciências da Universidade de Lisboa (GEOFCUL), Instituto Geológico e Mineiro (IGM), Instituto de Ciência Aplicada e Tecnologia (ICAT) and Sociedade Minera de Neves Corvo (SOMINCOR). The three-day meeting at the University of Lisbon will focus on the geology and genesis of massive sulfide deposits and present-day oceanic equivalents. A full-day symposium is dedicated to the presentation of the results of a major research investigation, funded by SOMINCOR, on the geology and genesis of the Neves Corvo massive sulfide deposits. This research covers a broad spectrum ranging from regional geology through mine geology to detailed petrologic and geochemical investigations relating to the Neves Corvo deposits. Invited keynote speakers include: Jim Franklin (Ottawa—SEG), Michael Russell (Glasgow-IMM) and Peter Herzig (Freiberg-SGA). The conference is expected to attract international participation and will provide an excellent opportunity for discussion on the newest developments relating to massive sulfide deposits, particularly with respect to the relationships between modern, submarine hydrothermal processes and their fossil counterparts, the VMS deposits.

Three field trips are planned. A three-day field trip, including an underground visit to the Neves Corvo Mine, will be held both pre- and post-meeting. Space on this trip is limited to 120 persons (six groups of twenty each). Two other field trips will accommodate another 120 participants. One in Portugal will focus on regional geology and a visit to the Aljustrel Mine. The other trip will be held in Spain with visits to Rio Tinto and Aznalcóllar.

At this time, the organizers are issuing a request for proposals of interest and call for papers. Abstracts are solicited for both oral and poster presentations on topics directly related to massive sulfide geology and genesis, and present-day submarine hydrothermal activity. All abstracts should be submitted in English, the official language of the conference. More information on the conference will be available in the July, 1996 issue of the Newsletter.

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SEG STUDENT NEWS

Grants from the SEG Foundation in 1996

■ Student Chapter Field Trip Fund. Guidelines for this program which was announced in the July, 1995 issue of the Newsletter (No. 21), are being developed by the Student Affairs Committee and will be submitted to the SEG Executive Committee for approval by mid-year. An amount of $4000 will be available to support student chapter field trips in 1996 and will be increased to $6000 in 1997. Allocations are likely to be up to $2000 to any one student chapter. The purpose of the grants is to subsidize the logistic costs of field trips, and thereby lower the cost to participating students. Student Chapters wishing to apply for support from this program in 1996 should contact:

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■ SEG Luncheon Subsidy for Students. Members of student chapters, as well as individual students enrolled in economic geology courses, wishing to attend any SEG luncheon (e.g., at GSA, Denver, Colorado, October 1996) should be aware that the SEG Foundation has funds available to partially subsidize the cost of the luncheon for students. The Foundation will provide 50 percent of the cost of the luncheon to qualifying students. Those wishing to take advantage of this subsidy should submit their requests through the SEG Executive Director.

PRESIDENT OF PUBCO

Paul K. Sims, President of the Economic Geology Publishing Company (PUBCO), recently announced his intention to complete his service as President in October 1996, the end of his current term. Paul has been President of PUBCO since 1979. This is a volunteer position with the responsibilities to guide PUBCO which publishes the journal Economic Geology. A committee has been formed to nominate a successor. Please send your suggestions for candidates with any supporting material to:

Samuel S. Adams
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EXPLORATION REVIEW

ALASKA

Regional Correspondent: Madelyn Millholland (SEG 1987)
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According to the State of Alaska over $34 million was spent on mineral exploration in the state in 1995, an increase of 9 percent over 1994. Development expenditures reached $148 million in 1995, reflecting a 23 percent rise. State funding for airborne geophysical surveys and the exploration incentive tax credit bill helped put Alaska in front page headlines in international mining journals last year and funding for additional airborne surveys is being sought from the legislature in 1996. The results of the third annual airborne survey flown last year in the Mariner-Ramparts area, central Alaska, were released by the State in early March.

SOUTHEAST ALASKA

Green’s Creek Mining Co. is scheduled to be back on site by January 1, 1997. Mined reserves are 8.5 million tons at 0.17 oz/t Au, 21.4 oz/t Ag, 5.1% Pb and 13.9% Zn. The mine will produce three concentrates (440 tpd) consisting of zinc, lead, and bulk concentrate which will be shipped to smelters in Canada, US, Japan, Korea, and Europe. In addition they will produce a doré on site from a newly installed gravity circuit. In the first and subsequent years, the mine will produce 62,000 oz. Au, 150,000 troy oz./yr. of concentrate containing over 10 million oz. Ag, 40,000 troy oz. of Zn and 20,000 troy oz. of Pb. The ore is contained in three zones which typically occur at the interface between phyllic and argillic rocks. To date, the known extents of the ore zones are 3,500 ft. Laterally, 3,000 ft. vertically and open north-south and down dip. Each zone is characterized by massive sulfides and white (carbonate, bannite) ores with variable gangue. The deposit is thought to have developed in a late Triassic back arc basin at, or near, a volcanic-sediment interface in an extensional rift environment.

Echo Bay Alaska Inc. has announced a draft revised mine plan for the 3 million ounce Alaska-Juneau (AJ) deposit. The original plan utilized “stoping under reserve fill” as the preferred mining method, and called for mining 22,500 tpd per day. The draft revised plan calls for utilizing sub-level caving, a more selective mining method, at a rate of 15,000 tpd per day. The revised plan also calls for the removal of the cyanide circuit from the mill flow sheet, with most of the gold reporting to the gravity circuit. The flotation concentrate will be shipped off-site for beneficiation. Tailings disposal continues to be a subject of much consideration.

Coeur Alaska is in the final permitting of the Kensington gold mine. This deposit contains over 1.96 million ounces of gold in the proven and probable categories. Coeur anticipates the mine life to be 12 years, with a workforce of 250 and mining at a rate of 4,000 tpd per day by long-hole open-stopping. Workers will work a rotation schedule from an on-site camp, with access to Juneau by helicopter. Annual production is targeted for 259,000 ounces. Ore will be beneficiated by flotation augmented by carbon-in-leach processing. Permits needed to get the ball rolling at Kensington could be in hand by as early as the third quarter of 1996.

Westmin continues to be active in southeast. They will be looking closely at their properties in the Duncan Canal and have acquired a land position on Admiralty Island from Pacific Northwest Resources in an area believed to be the extension of the Green’s Creek horizon.

In 1995 Sealaska Corp. (an Alaska Native Corporation) drilled the Devonian volcanic section on the Cornwallis Peninsula and report that the prospect is ready for further exploration drilling. They are seeking venture partners.

On Prince of Wales Island American Copper and Nickel Co. (ACNC) will continue their evaluation of their VMS properties at Hetta Inlet next summer and Abacus, along with their new partner Teck, will continue proving up the Niblack property.

SOUTHCENTRAL ALASKA

ACNC has plans to fly airborne geophysical surveys in the Alaska Range and drill in the Delta District (Devo-Mississippians targets in the Yukon-Tanana terrane). This, in addition to the acquisition of 60 square miles of mafic and ultramafic rocks with copper, nickel and platinum anomalies in the Eureka area, will keep them busy next year. That is if they don’t get their funding caught up in INCO’s battle for the Voicey’s Bay deposit.

Westmin has notified Hunt, Ware, and Proffett (HWP) that they will continue their participation in HWP’s lease on Cook Inlet Region Inc.’s (CIRI, an Alaska Native Corporation) volcanic-hosted Zn-Pb-Au prospect at Johnson River.

EASTERN INTERIOR ALASKA

Sumitomo Metal Mining Co. has encouraging results from their Stoneboy project on the Goodpasture River, northeast of Delta Junction. A total of thirteen diamond drill holes were drilled on a 16,000 sq. km lease that Sumitomo has with WGM. The drilling established a 197 m horizon with an average grade of 1.1 g/ft Au. Two holes encountered significant high-grade mineralization—6.9 m grading 63 g/ft Au at 180.7 m depth and 8.4 m grading 11 g/ft Au at 208.8 m depth. Over 4000 meters were drilled and 65 line-km of I.P. survey were run.

International Ballater Resources Inc. acquired, by assignment, a lease/purchase agreement with Canadian Gravity Recovery Inc. on 12 claims, known as the Silver Lining prospect, 42 miles north of Tok. The property is located along the Taylor Highway in the 69 m.y Mt. Fairplay syenite intrusive complex. Mineralization is controlled by joints and vein swarms with gold grades “up to 0.225 oz/t” with associated arsenic, lead and copper mineralization. Great Basin Exploration and Mining completed a limited program on this property in 1993, then dropped their lease.

Alpine Exploration Corp. has purchased the Gold Dust property in the Circle District for $110,000. The best hole from a drilling program in 1995 intersected 180 feet at 0.027 oz/t Au, including a 45-foot interval of 0.066 oz/t Au. This property consists of an altered granite cross-cut by gold-bearing quartz stringers.

FAIRBANKS DISTRICT

(EASTERN INTERIOR)

Fairbanks Gold is facing higher project capital costs at their Fort Knox property. Pre-stripping, process inventory and other working capital for the project will exceed the original estimate of $256 million by $50 to $75 million. The company reports that construction
and prestripping are underway and production of 350,000 oz. gold per year (from reserves of 4.1 million ounces of gold at the modest grade of 0.025 oz/t) is still on schedule for the fall of 1995. The ore will be processed on site by gravity concentration and cyanide leach/carbon-in-pulp (CIP) milling. Perhaps the Vancouver Sun (12/29/95) got a little carried away when they called Fort Knox “North America’s biggest gold mine.” Biggest or not, the fine new CIM volume, *Porphyry Deposits of the Northwestern Cordillera of North America*, ed. by T.G. Schroeter, offers a comprehensive article on the geology of the deposit.

At Fairbanks Gold’s (80%) and Teryl Resources’ (20%) Gil claims, adjacent to Fort Knox, a soil grid extended the mineralization along strike to the west and drilling defined a mineralized zone with a strike length of over 1,000 feet with 16 out of 18 holes encountering “economic” gold values. The mineralization appears to be stratabound within a metamorphic sequence containing two or possibly three calc-silicate horizons. Fairbanks Gold will conduct a $200,000 exploration program on the property in 1996 which will include 6,000 feet of drilling, soil sampling, and ground geophysics.

Newmont continues to have a positive outlook on the True North property in the Fairbanks district. Encouraged by the results from their November drilling campaign, Newmont is sending two full-time geologists to Fairbanks to begin a winter drilling program. Newmont paid LaTeko, owner of the property, $1 million, as the second installment under their joint venture agreement. LaTeko received $2.5 million in a previous payment. LaTeko estimates that True North contains a resource of two million-plus ounces.

**WESTERN ALASKA**

USMX has completed the feasibility study on the Illinois Creek deposit, a ferraluginous gossan hosted by probable Silurian age siliciclastics and calcareous sedimentary sequence. Approvals on all permits should be in hand by mid- to late-April if all goes well. A consolidated permit application package was submitted to the State of Alaska the first week of February. By mid-February the State of Alaska Department of Natural Resources had issued a notice of their preliminary finding and decision to issue a millsite permit for construction, operating, and maintaining infrastructures at the mine site. Once all the permits are secured, the Board of Directors will make a decision regarding construction. USMX has already secured a $22 million credit line from N.M. Rothschild to help with the projected $26.6 million project costs. Construction could conceivably commence in June with production late in the third or early fourth quarter. Once in operation, this mine will be the northernmost heap leach operation in North America. Plans are to mine six months per year with heap leaching year-round. Reserves remain at 5 MM tons with an equivalent gold grade of 0.074 Au ounces per ton. The actual gold grade is 0.069 ounces per ton. Plans are to produce 50,000 ounces per year over the next five years.

In addition to Illinois Creek, USMX is bullish on Alaska. They are eyeing targets adjacent to the Cretaceous Round Top porphyry system which lies within CIRI’s 62,000 acres of Alaska mining leases surrounding Illinois Creek. And the company has ventured forth to consider a deal with the State of Alaska’s Mental Health Trust Authority (readers may remember the extensive and complicated land battles over the Mental Health Trust lands a few years back) on an auriferous intrusive complex, surrounded by gold placers, in the Ophir District.

Consolidated Nevada Goldfields (CNG) and Doyon Ltd. (an Alaska Native Corporation) negotiated a 25-year minerals exploration agreement covering 46,000 acres of land owned by Doyon adjacent to CNG’s Nixon Fork gold mine. Doyon will receive a $4 million lease fee (2/3 in cash and 1/3 in shares of CNG), as well as a 1% NSR from the Nixon Fork mine until 500,000 ounces of gold have been produced from new discoveries on the Doyon leasehold, at which time production from the leasehold will bear a 5% NSR. Lease fee payments are to be made over three years. CNG plans to spend $2 million on drilling and regional exploration in the Nixon Fork area in 1996, exploring for additional deposits associated with skarn at the contact between limestone and a quartz monzonite stock and investigating the potential for “Carlin-style” gold mineralization in the carbonate rocks. In November, 1995, CNG produced over 4,500 ounces of gold from the Nixon Fork mine from head grades averaging more than 2.5 ounces of gold per ton. CNG reports that grades have been consistently higher than anticipated and the C-3000 orebody appears to be larger than predicted. CNG began the first phase of underground exploration and development drilling at Nixon Fork in January. The second phase surface diamond drilling is planned to begin in May.

Placer Dome US (PDUS) has begun to implement their multimillion-dollar program on Calista’s (an Alaska Native Corporation) Donlin Creek gold property. They are building a major camp and airstrip and have already hired a fleet of top-notch geologists to log the core which will be produced voluminously from the five rigs that will be turning. By the end of this program they hope to have something worth testing to feasibility. Donlin is one of a series of prospects and properties associated with 65 ma felsic dikes and sills which intrude Cretaceous flysch within a 500-mile long belt throughout the Kuskokwim Mountains. Gold is associated with arsenic, antimony and mercury sulfides within and commonly concentrated at the margins of the intrusives. Previous exploration by Westgold Inc. at Donlin Creek suggested a resource of about 380,000 ounces of gold with
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--- from Exploration Review, Cont. ---

grades of about 0.088 ounces per ton. PDUS has had more encouragement than that. They have announced an estimate of 3.6 million ounces of gold in 44.6 million tonnes grading an average of 2.5 grams of gold per tonne.

PDUS is also active in the Livengood District, where they conducted a close-spaced airborne geophysical survey, and in the Innoko District where they have signed a lease with placer operators at Gaines Creek.

NORTHERN ALASKA

The State of Alaska is considering assisting Cominco Alaska Incorporated with $60 million in additional financing to expand the Red Dog Mine port and offshore ore loading facilities. Cominco would provide its own $50-million-plus to expand at the minesite.

NANA Regional Inc. (an Alaska Native Corporation), owners of the property, unanimously passed a resolution approving an expansion of up to a maximum of 3.5 million tonnes of ore per year. In 1995 production at Red Dog increased significantly—585,200 tonnes of zinc concentrate and 91,900 tonnes of lead concentrate were produced, reflecting an increase of 10 percent and 70 percent respectively, from the prior year. The current reserves and resources at Red Dog are:

<table>
<thead>
<tr>
<th></th>
<th>Tonnage</th>
<th>% Zn</th>
<th>% Pb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Zone (Indicated Ore)</td>
<td>52,000,000</td>
<td>19.5</td>
<td>5.3</td>
</tr>
<tr>
<td>Agpaluk* (Inferred Ore)</td>
<td>76,000,000</td>
<td>13.7</td>
<td>3.6</td>
</tr>
<tr>
<td>Hilltop (Probable Resource)</td>
<td>9,600,000</td>
<td>17.8</td>
<td>5.5</td>
</tr>
<tr>
<td>Total Ore Reserves &amp; Resources</td>
<td>137,800,000</td>
<td>16.2</td>
<td>4.4</td>
</tr>
</tbody>
</table>

* previously called the North Extension

This reflects an 80 percent increase in the tonnage of zinc metal identified at Red Dog compared to a year ago.

Did anyone read the classifieds in the January Northern Miner? If you didn't, you missed the following advertisement:

ZINC/LEAD/SILVER PROPERTY—Located in NW Alaska approximately 12 miles from Red Dog Mine........Majority owner is seeking partner to assist in development. Contact Ray Kazorowski, GCO Minerals Company, Box 4256 Houston, Texas 77210. Tel. 713-651-9261, Fax: 713-951-4554, e-mail: PLBT51A@prodigy.com. Wow...an e-mail solicitation for the Lik deposit.

Kennecott Exploration activities include work in the Ambler District at Borkite where they have signed a 2-year option with NANA Regional Inc. and they will continue work on the Arctic deposit.

NANA conducted geophysical exploration over a polymetallic massive sulfide on corporation lands south of Deering.

SEWARD PENINSULA

In 1995 Kennecott Exploration drilled a total of 17,150 feet, trenched 10,518 feet and took 1,344 soil samples, completed 78.4 miles of ground magnetics on Bering Straits Native Corp. (an Alaska Native Corporation) and Sitnasuak (an Alaska Village Corporation) lands north of Nome. A resource of 10 million tons grading 0.071 ounces per ton gold is defined at Rock Creek. Kennecott plans a March drilling program on the Lindbloom and other areas near and geologically similar to, Rock Creek. Even if Rock Creek doesn't prove up for giant Kennecott, surely other mining concerns will find it attractive.
OTHER NEWS

Homestake, Western Mining, Hemlo and others have been taking the pulse of the Alaska exploration scene to see if anything strikes their fancy. Even Asarco made an offer to purchase in Alaska exploration by staking some of the most promising sites in the Fairbanks District, only to abandon them after deciding not to direct their exploration dollars to the north star state.

Kennecott's activities in the northwestern US and Alaska will take place under the direction of Pat Smith, who moves north from their Chile programs. And PDUS's effort in Alaska will be spearheaded by Richard Moses, who moves up from Spokane and various international locations. Welcome, Pat and Richard, to the north star state!

The Alaska Miners Association spring conference, Mining in the North Country—The First Hundred Years, was held in Fairbanks the week of March 5.


WESTERN UNITED STATES

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As the new heading implies this column has been expanded to include the entire western US; therefore, I need some help. Those of you outside the Great Basin (this column continually goes out within the Great Basin) please send me any information that you can share. In addition, I am looking for brief geological descriptions on new deposits.

ARIZONA

Royal Oak Mines is exploring the down-dip extension of the Copperstone (mined by Cyprus) deposit in La Paz County, Arizona. They are reporting a resource of 2.4 million tons of 0.17 opt Au. Gold mineralization is in a series of north-plunging shoots along the Copperstone fault, which is also the contact between a porphyritic quartz latite tuff and limestone. Remember the period of detachment fault gold deposits? This was then, wasn't, and probably still isn't one.

CALIFORNIA

Glamis Gold is pushing ahead with a feasibility study and permitting of the Imperial project. Imperial is midway between the Picacho and Mesquite mines, in extreme southeastern California. The deposit is reported to contain a mineral reserve of 89.9 million tons with an average grade of 0.017 opt Au and a stripping ratio of 2.9:1.

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Gold mineralization is hosted by iron-stained gneiss, with minor, and localized, argilization, representing about the only visible alteration. Mineralization is in the upper plate of a low-angle fault that may have a gravity slide origin. In places, gneiss sits on gravel. There is only one small area where mineralization comes to the surface, otherwise, the deposit is covered by several tens to a few hundred feet of alluvium. Development is scheduled in about two years, or as soon as the usual environmental issues are resolved.

U.S. Energy is still seeking a partner to develop their Lincoln deposit along the Mother Lode at Sutter Creek, Amador County, California. For those who have not seen this area, the portal is immediately north of the town of Sutter Creek, which is becoming a bedroom community for the towns in the Central Valley. An easy place to permit a mine!
Golden Queen has been actively drilling their Soledad Mountain property in Kern County, California. They are now reporting a reserve of 21 million tons of 0.028 opt Au and 0.50 opt Ag, but I understand that it is even larger. Precious metal mineralization occurs along a series of subparallel, steeply dipping quartz veins that fill fault zones in a pile of Tertiary volcanic rocks. This is a resource that will only get larger as more drilling is completed and the geology becomes better understood.

For those of you that think California is an impossible place to permit a mine, read Canyon Resources' third quarterly report. They have received all the necessary permits and have started construction at the Brigg Mine, Inyo County. Gold production is expected in the second half of 1996.

Siskin Gold Corp. has placed the San Juan Mine into production in Nevada County, California. San Juan is a Tertiary placer deposit along the ancestral Yuba river in the Mother Lode country of the Sierra foothills. Current head grades are about 0.15 ounces per bank yard of gravel.

IDAHO

Hecla Mining Co. and Great Lakes Minerals, Inc. have decided to write down the value of the Grouse Creek Mine in Custer County, Idaho. To quote Hecla, "the deposit will have a significantly shorter mine life and fewer ounces recovered." This is yet another case of computer ore reserves run amuck, probably brought about by improper drilling, lack of geological control in building a model, and letting the computer (and engineers) have its way. How many more deposits need to be written down before it becomes clear that geology and proper controls on the distribution of grade are too important to be ignored?

NEVADA

Aur Resources have announced a gold discovery on their Coleman Canyon property in Elko County, Nevada. The news release reports several gold bearing intervals in drill holes and trenches ranging from 0.02 to 0.04 opt Au. Mineralization occurs in shears in Paleozoic sedimentary rocks, and gabbroic and monzonitic intrusions. Aur Resources has completed only a single fence of holes across the property, yet the Great Basin rumor mill is in full swing. To hear it on the street one would think that trucks and shovels are on order.

Do you want to start the day in good humor? Just place your fax number on corporate new releases lists. They are commonly sent out overnight, so that in the morning they can be your first read. For instance—A recent release from Coral Gold and Levin Resources concerning their recently completed drill program on the Norma-Sass property near South Pipeline/Pipeline (isn't every property in central Nevada?), Lander County, Nevada. They report that "all holes have intersected heavy mineralization." Is that galena? The release then goes on to report that of the most important intercepts (2 out of 8 holes), the best is 170 feet of 0.0295 opt Au and the second is 10 feet of 0.014 opt Au at a depth of 510 feet. Need I say more?

AMAX Gold has resumed drilling at Coral Gold's Robertson project, near South Pipeline/Pipeline (it really is), Lander County, Nevada. Drilling in the porphyry zone may be expanding the reserve. Also, drilling in the Altenburg Hill and Gold Pan zones have encountered significantly higher grade gold mineralization than previously identified. One hole is reported to contain 140 feet with
an average grade of 0.1595 opt Au. Several other holes contained intervals of 0.05 opt Au. After several years of exploration it seems that AMAX may be finding the higher grades that will help make this an economic success.

Dec Mining is starting to develop the new Deep North orebody, which contains about 600,000 ounces of gold and will add about seven years to the mine life, if... There is a need to obtain pit layback rights on to FMC Gold's Rossi property to the north. Of course this issue is in litigation. There may also be underground potential that would be addressed later. The Dee mine is the northwesternmost producer along the Carlin Trend, Elko County, Nevada.

Fairmile Acquisitions Inc. is currently conducting an aggressive drilling program in the Buffalo Valley Mine area, Lander County, Nevada. Several holes have intersected deep high-grade intervals (such as 15 feet of 3.73 opt Au) along a northwest projection of the fault zone that controlled mineralization at the Buffalo Valley Mine. Two holes to the southeast of the mine have intersected several zones of mineralization closer to the surface. All of the gold mineralization is in Hualapai Sequence rocks, but some is closely associated with granodiorite intrusions.

Bob Schmuck may have had his 15 minutes in the spotlight by making the Pemex (Nevada) Lander-Dayton Courier newspaper. The quote relates to Phelps Dodge's drilling at the Hydra property in Lyon County, Nevada. Rumors are floating round that they have a gold intercept(s). Is this another Olinghouse that will be sold once a deposit is discovered?

Homestake Mining has decided to proceed with the development of the Ruby Hill deposit in Eureka County, Nevada. A feasibility study has identified a proven reserve at West Archimedes of 7.6 million tons grading 0.099 opt Au, including a high-grade core of 1.9 million tons with an average grade of 0.235 opt Au. There are still the East Archimedes, Deep East, and Achilles deposits that have not been fully delineated, which should add substantially to the reserve base.

Alta Gold Co. continues to report results from Olinghouse (Washoe County, Nevada) and the Kinsley Mine (Elko County, Nevada). At Kinsley, drilling seems to be replacing reserves as fast as mining depletes them, and is also identifying potential new deposits. While pushing ahead with development of the Olinghouse deposit drilling is also identifying high-grade mineralization that may represent extensions of the deposit(s). One core hole intersected 65 feet grading 0.381 opt Au, whereas reverse circulation holes encountered intervals such as 30 feet of 0.685, 40 feet of 0.905, and 70 feet of 1.040. These intervals are all in ounces of gold per ton, and in separate holes.

Echo Bay Mines is in the second year of a three-year exploration program at Round Mountain, in Nye County, Nevada, and guess what? They are expanding the reserves! The deposit is still open on several sides, but the reserves are placed at 348.9 million tons with an average grade of 0.022 opt Au, containing 7.8 million ounces. If that isn't enough, they also report a geologic resource of 107.4 million tons with and average grade of 0.024 opt Au, outside of the reserve. This reminds me of the prospector that I encountered several years ago. He said he had a gold-bearing quartz vein that was so large you couldn't tell if you were walking across it, or along it.

Cornucopia Resources is reporting a positive feasibility study at their Mineral Ridge property, near Silver Peak, Esmeralda County, Nevada. The study places the mineable reserve at 5.2 million tons with an average grade of 0.068 opt Au. They have applied for permits to develop an open pit heap leach operation.

At the January Geological Society of Nevada meeting Eric Berentsen delivered a talk on the Turquoise Ridge geology. The following is my attempt to summarize that discussion.

The important structural feature is the intersection of the northeast-striking Turquoise Ridge fault zone with a dome that formed when a northeast-trending anticline was folded by a compressional event at right angles. Western assemblage rocks are exposed at the surface, with Comus and Preble formations at depth. In addition to the fault zones, members of the thinly bedded Comus calcareous shales are the principal gold hosts. The bulk of the gold formed about 86-83 Ma during a sequence of mineralizing events (oldest to youngest) starting with quartz-pyrite and minor gold, quartz-marcasite, chalcopyrite-tennantite, and quartz-gold (major gold event). About 42 Ma, there was an arsenic-antimony-pyrite-minor gold event. FirstMiss is starting the underground development and is planning to drill out the deposit on 50-foot centers, with production anticipated in 1998.

OREGON

Rumor has it that Newmont Gold is producing positive results at Quartz Mountain, Lake County, Oregon. They may have +1 million ounces of gold at an average grade of about 0.05 opt Au. This is property that has always been considered metallurgically difficult and is in Oregon, which is not known to be mining friendly. Newmont recently wrote-off its investment at Grassy Mountain in Oregon.
EASTERN CANADA

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The new year ushered in a gold price that leapt over the US$400 per oz mark and seemed to take many by surprise, as did the so-called “biggest mining deal in history” between Falconbridge and Diamond Fields Resources. Perhaps not so surprising was the increase in reserves at the Voisey’s Bay Ni-Cu-Co deposit announced in early January—everyone accepts that Voisey’s Bay is a big deposit and expects it to keep growing. Other news from exploration plays in Labrador has slowed to a trickle as most Diamond Fields wannabes avoid the harsh winter conditions and plan their next move. Gold remains a focus of exploration in Eastern Canada, although recent success has been achieved in the search for massive sulfides in New Brunswick.

Ni-Cu

The biggest news from Eastern Canada this year, perhaps for many years, involves the fate of the massive Voisey’s Bay Ni-Cu-Co deposit. On February 9th, seemingly out of the blue, Falconbridge Ltd. launched a $4-billion bid for Diamond Fields Resources Inc., and control of the Voisey’s Bay deposit. The bid came shortly after the release of the latest drill results from the Eastern Deepes zone, discovered last fall, which confirmed the suspicion that it could significantly increase reserves. The Eastern Deepes zone has now been delineated over a strike length of 700 meters and a width of 300 meters. Massive sulfides up to 54.2 metres thick were intersected in the latest round of drilling. These results are expected to more than double the current reserves, estimated last July at 31.7 million tonnes grading 2.83% Ni, 1.68% Cu and 0.12% Co.

Inco, presumably stunned by the Falconbridge offer, is in the uncomfortable position of having to tender a better offer to protect its number one spot with 50% market share of world nickel. Falconbridge, currently with 14% of the nickel market, would come close to Inco’s premier position with the acquisition of Voisey’s Bay, and would also be the world’s lowest-cost nickel producer. At the time of writing, Inco was tightlylipped about possible plans, but institutional investors were voicing concerns about the dilution effect on Inco stock if a bidding war began.

Diadem Resources is planning over 1500m of drilling on their Pekan River Property 50 Km south of Wabush in western Labrador, after grassroots exploration led to the discovery of a mineralized zone, grab samples from which assayed up to 1.43% Cu, 0.72% Ni and 0.04% Co.

GOLD

Gold exploration has been concentrated in and around established mining camps in Ontario, with the Red Lake and Porcupine (Timmins area) camps being particularly active. Activity in the Red Lake district of northwestern Ontario, a camp that has already produced over 16 million ounces of gold, has been described as a mini gold rush. The interest appears to be partly due to the
success of Goldcorp Inc. and Placer Dome Inc. in deep exploration of their Red Lake Mine and Campbell Mine, respectively.

Goldcorp Inc. decided last February (1995) to begin a two-year exploration and development program in the Red Lake Mine at a cost of $10 million. To date, the exploration has outlined an additional 1.6 million ounces of gold, with 600,000 ounces in the probable and possible categories. The mineralization is hosted mainly by variably carbonated mafic volcanics in or adjacent to deformation zones. Several different types of mineralization are present including: cm- to m-scale quartz veins surrounded by sulfides; intensely silicified, complex replacement ore containing arsenopyrite, pyrite, and pyrrhotite; and quartz-carbonate ore, with low sulferic content but containing visible gold. The quartz-carbonate ore has been delineated over a dip length of some 120 meters, and is spatially associated with an ultramafic body. This ore is particularly high grade, returning assays of up to 36.05 oz Au per ton over 6.1 meters in the exploratory drilling. Due to the success of the underground exploration, Goldcorp plans to triple production to 150,000 ounces gold per year, and cut production costs by 50% to US$150 per ounce. A further $3 million will be spent over the next two years to explore the immediate area of the quartz carbonate ore.

Elsewhere in the Red Lake District, Madsen Gold is planning to resume production at the Madsen Mine and is also exploring several adjoining properties. Proven and probable reserves at the mine total 825,000 tonnes grading 9.5 g Au per tonne. Surface sampling by East West Resources on their Heyson Township Property has revealed high gold content in shear-zone-hosted quartz veins. In addition, Barrick Gold appears set to explore properties in the district acquired through the Lac Minerals takeover last year.

Placer Dome is exploring properties around its Detour Lake Mine in northern Ontario. Recent drilling on the Fault Lake property of Pelangi-Larder Mines intersected low-grade gold mineralization over widths up to 50 meters. Gold occurs in quartz veins and sulfide-rich stringers hosted by altered basalt. Alteration consists mainly of biotite and carbonate.

Placer Dome also announced recently that they will finally bring their 89% owned Musselwhite deposit into production at a capital cost of $100 million. Located in northwestern Ontario near Lake Opapimiskan, Musselwhite is a joint venture between Placer Dome and TVX Gold Inc. Musselwhite was discovered in 1980 during the course of drilling ground magnetic anomalies, some eighteen years after gold was first discovered in the area. The gold is hosted in highly folded oxide facies iron formation and occurs in two different styles: 1) stratiform disseminated mineralization, with most gold present as inclusions in pyrrhotite, and 2) steeply-dipping quartz veins hosting native gold. Proven and probable reserves of 11 million tonnes grading 9 g Au per tonne were previously outlined. Placer and TVX can also earn a 70% interest in the Opapimiskan and Karl-Zeemel properties of Pangaea Goldfields by investing up to $10 million in exploration and development. The properties lie to the north and south of the Karl-Zeemel property outlined 327,000 tonnes grading 4.6 g Au per tonne within 60 meters of the surface.

Meanwhile the Duport Gold project near Shoal Lake, northwestern Ontario has changed hands with the take over of Consolidated Professor Mines by Royal Oak Mines. The Duport deposit has a resource of 1.8 million tonnes grading 12 g Au per tonne, but has been under environmental assessment as Shoal Lake is the source of municipal water for Winnipeg.

Band Ore Resources has had some success with exploration drilling on their Thorne property west of Timmins, Ontario. Drill testing of the western extension of the previously outlined Kapika zone has returned average grades of 1.4 to 2.4 g Au per tonne over 2 to 5 meters. Drilling to the south has also intersected an altered zone containing pyrite, arsenopyrite and visible gold. The Kapika zone, with initial resource estimates of 270,000 tonnes grading 2.5 g Au per tonne, is an altered deformation zone situated north of the Desor-Porcupine fault. Mineralization is hosted by silicified porphyry and sericite schist. Further potential exists to the north of the Thorne Property, where the Bristol Township property has a preliminary resource estimate of 720,000 tons grading 0.11 oz Au per ton. Band Ore can earn a 70% interest in the property from Holmer Gold Mines.

Pre-feasibility work on the Penn-Gib property of Pangaea Goldfields Inc. near Matheson, Ontario indicates a mineable reserve of 3.5 million tonnes at an average grade of 4.2 g Au per tonne occurring in two zones. The main zone is a large, low-grade (0.5 to 3 g Au per tonne) zone of disseminated and quartz stringer type mineralization. High grade 7 g Au per tonne over 6 m, steeply plunging ore shoots within a lower grade (2 to 3 g Au per tonne) envelope comprise the deformation zone. Recent drilling has resulted in the discovery of another mineralized shear zone that returned an intersection of 3.2 meters averaging 3.5 g Au per tonne. Pangaea reports discovery costs of less than US$1.50 per oz for the Penn-Gib gold.

Cu-Pb-Zn

Stratabound Minerals intersected massive sulfides up to 5 meters thick during recent drilling on their Taylor Brook deposit near Bathurst, New Brunswick. The drilling extended the dimensions of the deposit over a strike length of 600 meters and to more than 400 meters down dip. Among
the best intersections were 5.9 meters averaging 2.71% Zn, 1.46% Pb and 27g Ag per tonne and 3.3 meters averaging 3.24% Zn, 1.55% Pb and 33g Ag per tonne. The mineralization consists of massive pyrite, pyrrhotite, sphalerite and galena, as well as pyrrhotite-chalcopyrite stringer-type mineralization that occurs in chloritized footwall volcanics.

In western New Brunswick, Novagold is taking advantage of investor interest in base metal plays to take another look at the Sewell Brook deposit which they discovered in 1990. The deposit is a volcanic-hosted massive sulfide similar to the Kuroko-type deposits, and is hosted by Devonian sediments and felsic volcanics. Massive sulfide mineralization is associated with felsic hyaloclastites and silicified silstones, and is underlain by a typical chlorite-sericite alteration pipe containing chalcopyrite-rich stringers. Earlier drilling on the property returned 2 to 5 meter intersections averaging between 3.7% Cu & 8% Pb+Zn and 17.44% Cu & 36.9% Pb+Zn.

Drilling by Chapleau Resources Inc. on their Shingles Gulch property, bordering the Sewell Brook property to the southwest, has intersected around 15 meters of mineralized volcanic breccia. Mineralization consists of 15 to 20% sulfide made up of galena, chalcopyrite and sphalerite.

**MEXICO**

Regional Correspondent: Robert Page (SEG 1986)
Mineras Noranda S.A. de C.V., Calle Central 118, Col. Periodista

The much hyped stratiform copper play in Coahuila has finally been drilled which, typically, has tossed the participants into a cold shower of reality. The target so extensive that it could not be missed is in fact there—if you drill deep enough. The problem is that surface intersections of 9 meters of 2% copper reduce in thickness and grade when penetrated by a drill hole. Somewhere in the Sabinas Basin, the top of the San Marcos Formation probably hosts a large, high-grade copper deposit. Unfortunately, it is now clear that finding it is going to take 7-figure budgets and a tenacity much greater than I am willing to demonstrate. The program will need a lot of deep drilling to produce enough intercepts to develop vectors towards more favorable stratigraphy, basin water, conduits, or improved mineralization. Noranda and Outokumpu failed the cash and tenacity test after a hole drilled from a location thought to offer the deepest exposure into the overlying stratigraphy, on ground held by the JV, had to be stopped at 600 meters still in capping limestone. (Amazingly, this hole was bone dry all the way to the bottom.) BHP, however, presses on with a thorough program typical of John Larson. They are said to have developed a model telling them in what direction to go within their 2500-square kilometer property. From my view, now on the sidelines, I am hoping they have success and that it comes on a property boundary with us.

Another hot bed of activity is around Nacozaú where Mexicana de Cobre, Noranda, Zapata (Phelps Dodge), and BHP all have drill programs in progress or just completed. Mexicana de Cobre is extending the Caridad deposit to the south so that there is at least one success story. BHP and Zapata are working on different parts of the Batanome porphyry located just north of the Florida Porphyry tested last year by Zapata. That test produced a lot of rumors and low-grade mineralization. Hopefully, Batanome will be different. Noranda’s property to the west across the valley-provided good
views of the activity at Batamate, and a lot of post-mineral cover in drill holes. The geophysics always look great, until drilled, at which point it becomes obvious what an alternative interpretation of the anomaly to be tested should have been.

As usual there is lots of gold exploration noise in Mexico. To summarize, some companies are drilling some veins in the Sierra Madre, some others are drilling small shear-hosted deposits in Sonora where they also have some placers, another bunch are working in old districts in the central plateau, and a few others are putting their 30,000 ounce-per-year deposits into production. For gold to be interesting, however, news of one of these little ones turning into big ones? I'd like to hear about a big one finally going to production. There is lots of rumbling about Mulasos, Bermejal, Nukay, Paredones, and La Herradura, but only the last appears to have escaped from feasibility to permit an actual production decision. This country has more gold potential than exploration results to date indicate. I hope to report about a big success in the near future.

Getting back to base metals, Grupo Industrial (IMMSA) is the pilot plant at El Arco and must be planning on developing the deposit. Meanwhile, they have been surrounded by Freeport which acquired a large claim around El Arco on the premise that there is one there should be another. There is certainly plenty of room under cover to the south of El Arco. Just a short distance away to the east at Santa Rosalia more tons keep getting added at Boole. The search has now extended to basins north and south of Boole with stratigraphically favorable results. I suspect the most important news, yet to be released, will state that Curator's pilot plant is up and running with good results. Tons and grade do not seem to be a problem.

The Dirección de Minas is now under SECOPFI (the secretary of commerce and industrial development), a good bunch of people except for the apparent fact that they know nothing about mining. The consensus is that there is at best uninformed leadership at the top in SECOPFI when it comes to mining matters. When the new Director of Mines was named last year, Luis Escudero Chávez (ex of Frisco), something like a thousand concessions were immediately titled and everyone thought there would be a smooth transition to SECOPFI. We all thought the improved productivity and responsiveness of the Dirección de Minas that had been seen in 1994 was going to continue. This does not seem to be the case. For example, last week both the Sabinas Agency and Saltillo Delegation in Cosahuila were closed down. Anyone needing to file surveys or other timely documents critical to staking or maintaining a concession in the area was out of luck. There was no alternative provided, and at least a few claims have gone bad.

A bigger issue for many of us is that it has been nearly 300 days since any invalid concession has been published as open. The list must be staggering. Prior to the start of this absurd moratorium 50 concessions a day were being released for staking. This indicates the backlog is now over 20,000 concessions. I know it affects Noranda on one project and I am sure we are not alone. There will be a concession that is vital to a project but which has been in limbo for 2 years. Every day that it is not published as "free" costs the project money by delaying work. Worse, the likelihood increases that another company will find the problem concession and decide to get in on the lottery when it is finally published as "free." Some nights do not sleep well.

As a last note, I want to apologize to David Giles and Fresnillo for attributing the Sabinas discovery adjacent to the San Martin mine to Penoles. This is a Fresnillo discovery. The Fresnillo team, led by David Giles, is an excellent example of the success that can be generated with a good program when there is continuity in staffing and an unswerving focus—even if the program is relatively small. Fresnillo's long term focus on central Mexico is producing successes at a rate any of us would be proud of.

SOUTH AMERICA

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[Editor's note: With this issue we introduce José Caballo as new regional exploration review correspondent for South America. José is currently employed by BHP Minerals as Exploration Manager, Northern Andes; his responsibilities include exploration activities in Bolivia, Peru, Ecuador, Colombia, and Venezuela. He has over twenty years of experience in Latin America minerals exploration, involving base- and precious-metals exploration and prospect development.]

Exploration continues at a high level in South America where Chile and Perú head the list. Argentina, a comparatively new entrant for mineral exploration, also provokes a major attraction for exploration players. Brazil is looking to revise current legislation which has restricted foreign mining and exploration activity; following proposed revision, exploration activity is expected to accelerate. For this reporting period, the most important news involves mine startups or the advancement of several successful exploration projects.

ARGENTINA

According to Argentina’s Mining Secretariat, RTZ, Barrick Gold, and Penoles are to sign contracts for mining exploration tenders in the San Juan province worth $60 million over five years. Also in San Juan province, Western Mining is to team up with Argentina Gold in a joint venture to evaluate the latter’s Rio Frio, La Poposa and Olivares properties.

CRA is to undertake a further drilling campaign at its Famatina gold and copper project, adding to resources discovered during drilling last year.

BOLIVIA

At their Orkho Norte prospect, Jordex Resources has obtained a significant zinc assay results from underground channel sampling. The zinc occurs within a breccia pipe intruding Paleozoic sediments. Geochemical sampling and
a drilling program should soon follow. Orvana Minerals has released a preliminary resource estimate for its Pederson gold deposit. Drilling results indicate a possible 1 million ounces at 1.8 g/t gold, with a further four exploration targets estimated to have an additional 3 million ounces.

**BRAZIL**

The Brazilian subsidiary of Willian Resources and Brazilian Resources has intersected important gold mineralization in its current drilling program at the Sabará property. The program is aimed at expanding and upgrading the previously estimated 600,000-ounce Au resource base. The property has known oxide mineralization to a depth of at least 100 m, being open below this depth.

Companhia Vale do Rio Doce (CVRD) has discovered a new gold deposit in Para state not far from its Serra Pelada gold deposit. According to initial drill indications, it could contain a resource of 150 t of gold. CVRD also has selected Golden Star Resources as the successful bidder for the Andorinhas gold project. Golden Star plans to start a 30-month program to expand the known orebodies and delineate new ones.

**CHILE**

Andacollo, a US $100 million gold project owned by Dayton Mining, moved into production in September, ahead of its projected January, 1996 start-up date. The deposit has minable reserves of 1.1 million ounces Au and the production capacity for 1996 is estimated at 140,000 ounces of gold.

Barrick expects to develop the Nevada open pit project at a capital cost of about $300 million. The deposit includes minable reserves totaling 48.1 Mt at 0.07 oz. gold per ton. Startup is projected for late 1998, with annual capacity forecast at about 350,000 ounces. Additional targets around the planned pit could augment reserves further.

Construction of the Refugio open pit gold mine was completed in December, 1995. The $127 million mine, a 50/50 joint venture between Amax Gold and Bema Gold, is expected to have an average annual production of 233,000 ounces Au. Mine life is projected at 9.4 years, based on reserves of 112 million tonnes containing 0.03 ounces of gold per tonne.

The Lukisk group and Equatorial Mining have reached an agreement over the joint development of their copper properties in the El Tesoro district. At an estimated cost of $200 million, the project should result in the production of 60,000 tonnes per year of cathode copper for a minimum period of 15 years. Preliminary resource estimates indicate some 168 Mt containing 0.93% copper at 0.43% cutoff.

Production has begun on schedule at Coeur d'Alene Mines new 100% owned Fachinal precious metals mine. Proven and probable reserves are estimated at 4.5 Mt ore containing 0.07 oz./t gold and 3.22 oz./t silver, enough for 7.5 years of mine life. During this year they expect to produce 44,000 ounces of gold and 2.7 million ounces of silver. Further exploration, currently underway, is expected to increase reserves.

Construction is to begin in mid-1996 at the Collahuasi District, I Region. The Comité de Inversiones Extranjeras has signed an agreement with Falconbridge International Ltd. and Minoro, S.A. for development of the Ujina (porphyry Cu-Mo), Rosario (porphyry Cu-Mo), and Huinquintipa (exotic chrysocolla) copper deposits. Production, scheduled to begin at the end of 1998, is anticipated to be 380 thousand tonnes/year of contained copper.

**ECUADOR**

TVX Gold has completed an exploration program encompassing drilling and drift sampling of the Pachicueta project. Reported resources are estimated at 1 million tonnes at about 13 g/t gold plus important silver, zinc, and lead credits. Based on the results to-date, TVX Gold has approved the construction of a development adit to intersect the mineralized structure at the bottom level of the outlined resources.

Cominco, in joint venture with Jersey Goldfields, is advancing exploration work on the Chinchinal gold project as well as at the Guarumales massive sulfide prospect.

**GUYANA**

Drilling by Canarc Resource Corporation has intersected multiple mineralized gold zones at its Lanna property. Mineralization occurs as both shear-zone hosted, gold-bearing quartz veins and as disseminated stockwork-related gold zones.

**PERU**

Magma Tintaya S.A. plans to spend $10 million on exploration around the Tintaya Mine during this year. The accelerated exploration program has been launched with a view to finding reserves to justify increasing mine throughput.

Barrick Gold Corp. is expected to make a decision during 1996 on possible production at its 75%-owned Cerro Corono property. They are presently conducting a feasibility study on this gold-copper deposit, estimated to contain 3 million ounces of gold and 450,000 tons of copper. Barrick has also begun drilling a program at a property situated near Yanacocha, a joint venture with Solitario Resources.

Newmont is planning to spend $4.5 million on exploration in 1996, in addition to activities at Minera Yanacocha.

The Metal Mining Agency of Japan reports a significant copper discovery in Cuzco province. Several diamond drill-holes have been completed in the discovery area, situated south of the Quechua porphyry copper occurrence previously examined by the agency in the 1970s.

Southwestern Gold expects to begin drilling at its Accha MVT type prospect, situated south of Cuzco. The company is to carry out an initial drilling program and plans further geophysical work to delineate additional drill targets.

**URUGUAY**

American Resource Corporation reports that it has discovered a new mineralized zone at its San Gregorio project. If proven continuous over a substantial strike length, the new zone will have significant impact on project resource estimates and feasibility economics.

**VENEZUELA**

Placer Dome and its joint-venture partner, Corporación Venezolana de Guyana, will conduct further exploration and definition drilling at the Las Cristinas gold project. Some effort will be devoted to satellite areas, including East Potaso and East
Conductors, as well as Mesones. Crystalex has begun a second phase of drilling at their Albino property in the Kilometer 88 region. An early result confirmed the presence of high-grade mineralization, giving 17.1 g/t Au over an intercept of 11.1 meters.

THE CARIBBEAN BASIN

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[Editor's note: Julio Espallat is welcomed as the new regional exploration review correspondent for the Caribbean. Julio is employed by Falconbridge Dominicana, C. P. O. A., and is involved with base- and precious-metal exploration in the Caribbean Basin. Julio has worked in massive sulfide exploration, as well as in Ni laterite exploration programs, and is based at Falconbridge's Ni mine in central Hispaniola. Julio's experience in minerals exploration spans nearly two decades, with emphasis on property evaluation and economic feasibility studies.]

Strong exploration activity is currently taking place in the major Caribbean islands. Cuba has been experiencing the most activity, with several mining and exploration companies exploring the mineral potential of the island. Hispaniola (Haiti 1/3 and Dominican Republic 2/3 of the island) has seen some recent exploration activity headed by private companies and international organizations. Several Au properties are currently being examined in Jamaica. No base and/or precious metal exploration is apparent in Puerto Rico, and only minor exploration activity for epithermal Au-Ag systems is reported from the Lesser Antilles.

BHP Minerals is presently conducting mineral exploration in Jamaica and the Dominican Republic with focus on porphyry copper-gold and epithermal gold systems. BHP recently completed a drilling program in the Dominican Republic, with results not yet available. Orvina Minerals, Kennecott Exploration, Orogande Resources and Clarendon Mining Limited are actively exploring for gold in Jamaica.

Falconbridge International (Investment) Limited (FIIIL) is currently exploring the Maimon, El Anon and Managua base- and precious-metal concessions in the Dominican Republic. Recently FIIIL and KWG Resources Inc. entered into a joint venture agreement in which KWG shall have the right to earn a 49% interest in FIIIL properties in the Dominican Republic by spending US $5 million over a maximum period of five years with a minimum expenditure per year.

Minera Hispaniola continued exploring their base-metal and gold properties in the Dominican Republic concentrating on epithermal Au-Ag occurrences.

A recent agreement between the Dominican Government and the European Economic Community (Lome IV) resulted in a sponsored program for an airborne magnetic and radiometric survey of the country. Other exploration work, including mapping, geochemistry, ground geophysics, drilling and evaluation of properties, are also included in the agreement.

KWG Resources Inc. is actively exploring five mineral permits in northeastern Haiti. These properties comprise several metalliferous deposits, including the Duvray (180m with 0.59% Cu), Blondin (50m with 0.50% Cu), Valliere (84 m with 0.44% Cu, 0.05 oz/t Ag) and Faille B (0.5 m containing 0.47 oz/t Au) deposits. KWG is also exploring in Cuba, where their joint venture with Geominera S.A., a Cuban state-operated agency, is exploring several properties. Recent sampling results from their Gaspar prospect included 3.01 gr Au/t over 140 meters from trench #1. An extension of 250 m. of the same trench returned 2.1 gr Au/t, including an interval of 8.0 m. averaging 2.9 gr Au/t. Trench #2, located 200 m. to the west of and parallel to trench #1, returned 1.35 gr Au/t over 38 meters. Two other trenches yielded 1.5 gr Au/t over 58 m. and 3.79 gr Au/t over 166 m., respectively.

MacDonald Mines Exploration and CaribGold are actively exploring precious- and base-metal properties in Cuba and Gencor and Western Mining are exploring for nickel laterite properties in central and eastern Cuba.
**DIRECTOR**

**Ralph Roberts Center for Research in Economic Geology**
**Mackay School of Mines, University of Nevada, Reno**

The Department of Geological Sciences, Mackay School of Mines, University of Nevada, Reno, invites applications and nominations for the position of **Director** of the newly formed **Ralph Roberts Center for Research in Economic Geology (CREG)**, which is presently pending approval by the Board of Regents. CREG is a joint research unit involving geologists of the minerals industry of the State of Nevada, faculty of the Department of Geological Sciences and scientists of the U.S. Geological Survey. The Center will initially focus on developing a better understanding of the characteristics, occurrence, geological controls and conditions of formation of Carlin-type disseminated precious-metal deposits, which are important to the State of Nevada. A multi-disciplinary approach involving deposit- to regional-scale stratigraphic, structural, geochemical, mineralogical, petrological, etc. studies will be emphasized.

The Director will be responsible for coordination and communication between the various individuals and groups involved, facilitating project activities and reporting results to a Steering Committee composed of senior-level geologists from the minerals industry. Along with other faculty, the Director will be involved in the initiation, implementation and supervision of various graduate student research projects. Time will be available for personal research, with the expectation of significant contributions.

The successful applicant should have a Ph.D degree (or equivalent) in the geological sciences and experience in mineral exploration and/or production. Research and publication in scientific journals, knowledge of sedimentary rock-hosted gold deposits and a record of productive scientific and professional involvement with individuals in industry, government and academia are highly desirable. The applicant must possess proven interpersonal skills and be able to deliver research products in a timely and cost-effective manner. The position is industry-supported, non-tenure track, funded for a minimum of two (2) years, with possibility of further tenure-track appointment, contingent upon funding, with a twelve-month salary and benefits based on experience and qualifications.

Applications, complete with letter of interest, summary of relevant experience, and the names of three or more referees, should be submitted to the Chairman, CREG Search Committee, Department of Geological Sciences, MS 172, University of Nevada, Reno, NV 89557. Additional information can be obtained from Dr. Richard Schweikert: Tel. 702-784-6901, FAX 702-784-1833, e-mail richschw@equinox.unr.edu; or D.C. Noble: Tel & Fax 702-784-6928. Application review will begin June 1. The University of Nevada is an affirmative action, equal opportunity employer.

**RESEARCH FELLOWSHIPS**

**Ralph Roberts Center for Research in Economic Geology**
**Department of Geological Sciences, Mackay School of Mines**
**University of Nevada, Reno**

The Department of Geological Sciences, Mackay School of Mines, University of Nevada, Reno seeks to fill several one-half time graduate research fellowships for studies on Carlin-type gold deposits in Nevada and related topics. The successful applicants will have strong backgrounds in one or more of the following areas: metallogeny, stratigraphy, structure, geochemistry, tectonics, petrology, and an interest in studying Carlin-type precious metal mineralization. A Bachelor of Science degree is a minimum requirement and a Master of Science degree is desirable. Candidates with a background in economic geology and experience in the minerals industry will be given preference.

The successful applicants will work on research projects under the direction of faculty, U.S. Geological Survey scientists, and industry geologists, with coordination and integration of their research into the goals of the Center by the Director of the Ralph Roberts Center for Research in Economic Geology. Most of the projects will have a major field component.

The fellowships will be funded competitively and funds will be provided for research expenses. Additional specific projects funded by industry may also be available. Interested geoscientists should contact the Department of Geological Sciences, MS-172, Mackay School of Mines, University of Nevada, Reno, NV 89557 for applications. The University requires that the Graduate Record Examination be taken and a satisfactory score achieved prior to consideration for admission. The completed application should be accompanied by a letter of interest citing a Carlin Research Fellowship and a statement of qualifications, along with the names and addresses of at least three references. The completed application package should be sent to the Chairman, Department of Geological Sciences at the above address. Application deadline for the 1996-97 academic year is June 01, 1996. The University of Nevada is an affirmative action equal opportunity employer.
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CANDIDATES FOR SEG FELLOWSHIP:

To ALL Fellows:

Pursuant to Article I, Section 2, of the Society’s Bylaws, names of the following 11 candidates, who have been recommended for Fellowship by the Admissions Committee, are submitted for your consideration. Each applicant’s name and current position are followed by the names of the three SEG sponsors. If you have any comments, favorable or unfavorable, on any candidate, you should send them, in writing, to the Admissions Secretary before June 15, 1996. If no objections are received by that date, these candidates will be presented to Council for approval.

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Finn, Dale R., Newman Mining Company, Helena, MT: J.N. Mayor, David A. Groves, Lewis Teal
Palinkas, Ladislav A., University of Zagreb, Zagreb, Croatia: Jeffrey W. Hedenquist, Ferenc Molnár, Edwin Roessler
Pressnell, Ricardo D., Kennecott Exploration, Salt Lake City, UT: Russell C. Babcock, William T. Parry, Eric U. Petersen
Ruvalcaba-Ruiz, Delfino C., Universidad San Luis Potosí, San Luis Potosí, SLP, Mexico: Tommy B. Thompson, Ken F. Clark, John A. Thoms
Serecen, Jargalan, Inst. of Geology & Mineral Resources of Mongolia, Ulanbaatar, Mongolia: Jeffrey W. Hedenquist, Masahiro Aoki, Shunso Ishihara
Stewart, Peter W., Phelps Dodge Corp. of Canada, Ltd., Winnipeg, Manitoba, Canada: Norman A. Duke, R.W. Hodder, Paul Chown
Swarthout, Andrew T., Southern Peru Copper Corp., New York, NY: Frederick T. Graybeal, J. David Lowell, Donald C. Bulner

THE SOCIETY ALSO WELCOMES THE ABOVE CANDIDATES AS NEW MEMBERS.

The Society Welcomes The Following

NEW SEG Fellows:
Donald K. Jennings, Consulting Geologist, Elko, NV; Manuel Reyes, Investigación Minera y Geología, Santiago, Chile; Paul T. Sarjeant, Ech Bay Mines Ltd., Denver, CO; Vitali I. Sotnikov, University of Novosibirsk, Novosibirsk, Russia; Barton J. Suchomel, Western Mining Corp. (USA), Santiago, Chile; Donald R. Taylor, BHP Minerals Inc., Monroe, NC; Francisco R. Velasco, Univ. Basque Country (Spain), Leioa, Spain.

The Society Welcomes The Following

NEW SEG Members:
Anita K. Appleby, Placer Pacific Ltd., Cairns, Queensland, Australia; Jonathan E. Benedict, Pathfinder Exploration Corp., Sparks, NV; David H. Bernosky, Santa Fe Pacific Gold, Winnemucca, NV; Wolf-Dietrich Bock, Consultant, Poseidon Gold, Freiburg, Germany; Paul S. Bosch, MB Petroleum, Mina Al Fahal, Sultanate of Oman; Jeffrey A. Cary, Hemlo Gold Mines (USA), Reno, NV; David L. Cooke, D.L. Cooke & Associates, Ltd., Vancouver, B.C., Canada; Ernest F.S. Downes, Consulting Geologist, Kent, WA; Peter C. Ellisworth, Consultant, Missoula, MT; Michel Gauthier, Univ. du Québec à Montréal, Montréal, Québec, Canada; David H. Graverson, Jr., Consulting Geologist, Slidell, LA; Ingar M.E. Haga, Outokumpu Mines Ltd., Toronto, Ontario, Canada; Miguel A. Heredia, Minera BHP, Hermosillo, Sonora, Mexico; Michael C. Joudrie, Minera Cominco Resources Chile Ltd., Santiago, Chile; Derrick C. Kettewell, MIM Exploration P/L, Brisbane, Queensland, Australia; Judy Kreps, Knight Piésold, Denver, CO; John S. Lee, Phelps Dodge Exploration Corp., Tucson, AZ; Robert J. Love, North Ltd., Parkes, NSW, Australia; Wilfredo Loza, Consulting Geologist, Lima, Peru; Paul D. McCarthy, C. Amelagro, Peru; Donald J. Schissell, BHP Minerals Int., London, United Kingdom; William M. Shalosky, Consulting Geologist, Lakewood, CO; Jonathan G. Standing, Placer Pacific Ltd., South Perth, WA, Australia; Vance V. Thornsberry, Echo Bay Mines, Philippines, Spokane, WA; Richard M. Tosdal, Consulting Geologist, Menlo Park, CA; Margaret E. Venable, Kennecott Exploration Co., Tucson, AZ; Serban N. Vladi, University of Cluj-Napoca, Cluj-Napoca, Cluj, Romania; Jesse D. Wellman, Teck Resources Inc., Reno, NV; John R. Wilson, Cyprus Minerals Co., Tucson, AZ.

The Society Welcomes The Following

STUDENT SEG Members:
Vicente A. Astacio, New Mexico Tech., Socorro, NM; Jennifer Becker, University of Arizona, Tucson, AZ; David M. Borrok, University of Michigan, Ann Arbor, MI; James L. Carter, Central Missouri State Univ., Warrensburg, MO; Sang Won Cheong, University of Nevada, Reno, Reno, NV; Johannes T. Hornsten, Scandiana School of Mines, Salzburg, Austria; Juri A. Kalnins, New Mexico Tech., Socorro, NM; Sten Littmann, Univ. of Mining & Tech.-Freiberg, Freiberg, Germany; Thomas E. Madigan, South Dakota School of Mines & Technology, Rapid City, SD; David L. Moore, Ball State University, Muncie, IN; Morgan J. Poliquin, University of Auckland, Auckland, New Zealand; Kyle A. Rhoderick, South Dakota School of Mines & Tech., Rapid City, SD; Steven M. Sellick, Univ. of Texas, El Paso, El Paso, TX; Shawn E. Sticker, South Dakota School of Mines & Technology, Rapid City, SD.

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PROTRANS CORPORATION

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personal notes & news

Career-Related Changes

- Cominco Ltd. has announced the following appointments: David W. Moore (SEG 1987) has been named Manager—Exploration, for Western Canada, with additional responsibility for Cominco’s exploration interests in Australia and the CIS; Michael J. Caselman (SEG 1994) has been named Administrative Manager—International Exploration. He previously was based in Santiago, Chile as Manager—Exploration for Minera Cominco Resources Chile, Ltd. Both Moore and Caselman are based in Vancouver, B.C.
- Murray W. Hitman (SEG 1978) has been appointed Fogarty Professor of Economic Geology at Colorado School of Mines, Golden, Colorado. For the past eighteen months, he has been a AAAS/Sloan Fellow in the Office of Science and Technology Policy, Executive Office of the President, Washington, D.C. He was formerly employed by Chevron Minerals Corporation as a minerals exploration geologist and manager, and has spent a large part of his professional career outside of the United States including assignments in Ireland, Spain, Canada and Papua New Guinea. He currently services SEG as Vice President for Regional Affairs.
- Larry Lackey (SEG 1977) recently joined MK Gold Co. as Manager of Exploration.
- Richard (Joc) Wagner (SEG 1976) has been named Vice President—Exploration for the Doe Run Company, St. Louis, Missouri. He will be responsible for Doe Run’s worldwide exploration activities and will continue as Chief Geologist for Doe Run’s Southeast Missouri Mining and Milling Division.

Awards & Accomplishments

- Jill D. Pastelis (SEG 1987), Professor of Earth and Planetary Sciences in Arts and Sciences at Washington University, St. Louis, Missouri, and a member of Washington University’s faculty since 1980, was selected by the University to receive the 1995 Emerson Electric Excellence in Teaching Award. The award recognizes outstanding teachers for significant contributions to the teaching profession and to their students.

Deaths

- George E. Erickson (SEG 1955, SF ’90), died at home on January 14, 1996 in Reston, Virginia, after a brief illness. He was a graduate of the Montana State University (BS ’48), Indiana University (MA ’49) and Columbia University (PhD ’54), and spent his entire career as a geologist with the U.S. Geological Survey. His investigations were concerned chiefly with the study of mineral deposits in the western hemisphere, especially the nitrate deposits of Chile. He is credited with discovering one of the largest lithium-rich deposits in Bolivia. He participated in the early planning and development of the Instituto de Investigaciones Geologicas de Chile (now the Geological Survey of Chile), the Esquela de Geologia, Universidad de Chile, and also assisted in establishing the Geological Survey of Peru. He was honored by the President of Peru in 1982. In 1983, he received the “Order of Bernado O’Higgins,” from the Chilean government, the highest honor that can be bestowed on a foreign civilian. He received the Distinguished Service Award from the U.S. Department of Interior in 1985, and in 1992, Bolivia awarded him the Medal for Meritorious Service to Mining. He authored over 100 research papers, abstracts, maps and books. He is survived by his wife Mary Frances Erickson.
- Lincoln R. Page (SEG 1957, SF ’88) died January 14, 1996 at Huggins Hospital, Wolfeboro, New Hampshire, of pneumonia. He was a graduate of Dartmouth College (AB ’51) and earned graduate degrees in geology (MA ’52, PhD ’57) at the University of Minnesota. He started his career with Standard Oil of Texas and spent one year as an Assistant Professor of Geology at the University of Colorado before joining the U.S. Geological Survey in 1939. He spent the remainder of his professional career with the Survey. During World Wart II, he worked in strategic minerals investigations and then in uranium resource investigations. He is known for his expertise as a uranium geologist. Following his work in uranium, he served as Chief of the New England Branch of the U.S.G.S. until his retirement. He then taught briefly at Dartmouth, and subsequently served as State Geologist for New Hampshire. He was preceded in death by his wife, Esther, and is survived by two sons, Milton and Norman. He was a strong supporter of both the Geological Society of America and SEG.

May 11-14, 1996, SEG Nevea Corvo Field Conference, Lisbon, Portugal, with co-sponsors: Instituto of Mining and Metallurgy (IAMM), society for Geology Applied to Metal Deposits (SGA), Departamento de Geologia de Faculdade de Ciências de Universidade de Lisboa (GEFDL), Instituto Geológico e Mineiro (IGM), Instituto de Ciência Aplicada e Tecnologia (ICAT) and Sonecros Mineira De Nevea Corvo (SOMINCON). Fernando J.S. Barros, Universidade de Lisboa, Edifico C2, Piso 5, Campus Grande, 1700 Lisboa, Portugal. Tel.: +351 1 750 9068, Fax: +351 1 759 9380, e-mail: NeveaCorvo@ctc.pt, or Geoff straw, ColoradoSEG, 5808 S Rapp St, Suite 209, Littleton, CO 80120, U.S.A. Tel. +1 (303) 797 0332, Fax +1 (303) 797 0417. Includes technical sessions, keynote speakers, and field trips to Nevea Corvo and the central and eastern Iberian Fynlie Belts, with a special on-day technical session reporting on results of a SOMINCON-funded major research program on the geology and genesis of the Nevea Corvo massive sulfide deposit.


Jul 10-12, 1996, Overview of Mesothermal Gold Deposits, Nedlands, Western Australia. An international symposium sponsored by the University of Western Australia and the University of Ballarat. D. Goues, Key Centre, University of Western Australia, Nedlands, WA 6009, Australia. Tel. +61 (8) 9223 2087, Fax +61 (8) 9223 1170.

Sep 4-7, 1996, Age and Isotopes of South American Metallogenic Provinces, Salinas, Bahia, Brazil. Final Meeting of ICGP Project 342, Arlada Mihi, ISU, Univ. Fed. Da Bahia, Rua Carlos Bosi, 123, Feeder, Piaui, Brazil. Tel.: +55 (71) 235 4753, Fax: +55 (71) 247 3004; e-mail: mihi@ufba.br, or M. Zenetti, Department of Earth Sciences, Dalhousie University, Halifax, NS, Canada. Tel.: +1 (902) 494 3373, Fax +1 (902) 494 0889, e-mail: mzenetti@dal.ca. Technical sessions and field trips to Serro-Itapicuru Gowerstone Belt, Fazenda Brasileira gold mine, Serra do Japi gold conglomerate, Chaquira plantain, and during and following Brazilian Geological Congress. Sep 1-6.

Sep 28-29, 1996, Mesozoic Geology of the Eastern Australian Plate, Brisbane, Queensland, Australia. Natalie O’Sullivan, P.O. Box 1280, Milton, Queensland 4064, Australia. Tel. +61 7 3399 0477, Fax +61 7 3399 1512. To p. 18. Issue No. 23 (October, 1995) for more details.

Oct 2-5, 1996, Epigenetic: Magmatic-Related Mineralization in the Southwest Pacific, Ballarat, Victoria, Australia. Sponsored by the University of Ballarat and Kingston Morrison Ltd. Auckland. W.R. Ramsay, Geology Department, University of Ballarat, Ballarat, VIC 3353, Australia. Tel. +61 3 279 261, Fax +61 3 279 944, e-mail: ws@bs. ballarat.edu.au. Nov 21-22, 1996, Advances in Saskatchewan Geology and Mineral Exploration, Saskatchewan, Canada. Saskatchewan Geological Survey conference. MINEOPE 96, PO Box 234, Regina, S.A. 226, Canada. Tel. +1 (306) 787 9181, Fax +1 (306) 787 2488, e-mail: bill.simonson@sasktel.sk.ca.