AN EPOCH OF GOLD RICHES:
The Late Paleozoic in
Uzbekistan, Central Asia

Byron R. Berger • Lawrence J. Drew • Richard J. Goldfarb • Lawrence W. Snee
U.S. GEOLOGICAL SURVEY

Mining has had a long history in Central Asia (Figure 1), dating from the Bronze Age when outcropping ores were sources of copper and gold. Many of the major gold deposits of this region formed in the middle to Late Carboniferous and Early Permian during tectonic and magmatic activity which was related to the convergence and eventual suturing of the Kazakhstan and Karakum-Tarim continental masses (Zonenshain et al., 1990). A number of the deposits are world-class, particularly the syntectonic vein systems at Muruntau and the gold-bearing Kalmaiky porphyry copper-molybdenum deposit at Almalyk, both in Uzbekistan. Deposit types in this area are diverse; other important gold resources are epithermal-type, stockwork molybdenum-tungsten quartz veins and skarns, lead-zinc skarns, polymetallic veins and replacements, and syntectonic shear-zone hosted arsenic-antimony-mercury and silver-base metal deposits.

Plate tectonics forms a familiar framework into which the known gold deposits in this region fit. Epizonal porphyry-style, polymetallic veins and replacements, and epithermal-style veins are related to an EW to NW trending volcano-plutonic magmatic arc formed in the middle to upper Carboniferous above north-dipping subduction. Syntectonic, shear-zone hosted gold, silver-base metal, and arsenic-antimony-mercury deposits are associated with a series of subparallel, regional wrench faults developed in a fold and fault belt south of the arc after suturing of the converging plates (Figure 2).

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1 Space permits only a limited number of references on the geology and mineral resources of this vast region. The reader is encouraged to consult the references in the papers cited and data bases for further information. In addition, reserves and mineral production information were not made available to us during our visit, and we have not sought to assemble them.
From The Editor

Alan Wallace, my esteemed predecessor as Newsletter editor, recently recounted a saying: "Managing scientists is like trying to herd cats." I like this, but would revise it: "Managing economic geologists is like trying to herd farm cats." No slander is intended to cat or dog lovers. Dogs tend to be loyal, trainable animals who prefer to work in packs. Cats, however, are highly independent, curious (to the point of danger), mysterious and territorial. Economic geologists tend to be independent, curious and territorial (staking claims on many levels).

What does this have to do with SEG? As I learn more about this society, I find striking parallels with the tendency for geologists to associate with loose, sometimes mysterious, always interesting, groups. Such characteristics are both the joy and frustration of participating in this society. Trying to balance the various interests of the society as an editor (see editorial policy articles) is a challenge. In particular, I hear much about the purpose of this society and its publications. Is SEG a scientific or a professional society? Should we support "basic" or "applied" science, or the "art" of exploration? Should we publish "pure" science or "applied" practical information?

I contend that, as SEG encompasses a wide variety of geologists, the society should welcome all "breeds." This means balancing the needs and interests of more than 3,000 independent thinkers. It means living with, even appreciating, the occasional tensions created by geologists wanting to move SEG (or the Newsletter) in many different directions at the same time. It means recognizing the importance of the 69% of SEG membership who work in industry and look for applied exploration practices, and, at the same time, understanding that, "pure" or "basic" science has led, and will lead the way to better applied science. Both the scientific and professional aspects of SEG are important and should be supported equally. Like it or not, SEG is both a professional and a scientific society. Let us welcome our diversity, even when it sometimes makes us look like a bunch of cats headed in different directions.

SEG Foundation

Initial Grants Awarded from the H.E. McKinstry Fund

In November, 1993 the initial grants were distributed from the SEG Foundation's H.E. McKinstry Fund. Of the sixteen applicants, five were selected by the Committee:

- **JOHN D. BERNT** (Stanford University): to complete a study of the "Tectonic evolution of the Jarbidge Mountain volcanic field and the relationship to quartz-adularia gold vein systems."

- **ANNE M. SASSO** (Queens University): whose topic is "Evolution and origin of porphyry Cu-Au and epithermal Au-Ag mineralization, Parallon Negro District, Catamarca, Northwest Argentina."

- **ARI L. KOGUT** (University of Missouri-Rolla): to extend a study of the "Rare earth element distribution, trace and major element chemistry, fluid inclusion analysis, and paragenetic sequence of the Okorusu fluorite deposit, North Central Namibia."

- **MELODY J. BROWN** (Dartmouth College): for a "Numerical and geological analysis of paleofluid-flow in the Central Midlands Basin, Ireland: developing a genetic model for the Irish base-metal ores."

- **DARRYL LINDSAY** and **MARCOS ZENTILLI** (Dalhousie University): to continue a study of "The structural control of the Chugucamata porphyry copper deposit."

An announcement will be made in 1994 when applications for additional grants are to be submitted.

Ernest L. Dille
SEG Foundation President

Hugh E. McKinstry Fund Committee

**NOTICES**

**SEG Newsletter No. 15 (October '93)**

Due to circumstances beyond our control (in the labeling step of distribution), mailing of the October '93 issue was delayed by at least one week. In addition, the bulk mailing used for U.S. members of SEG was delayed for unknown reasons. We are working to reduce future delays in the labeling process.

**Correction:** In Paul Bartos' lead article, Table 2 (page 6), the Sunnyside Mine box for "Boiling" should read that the ore sample of quartz that exhibited boiling was the post-cop Stage VI (6), or the quartz-flourite stage, as opposed to the gold-bearing Stage IV (4), in which no boiling was evident. The Editor regrets this oversight in proofreading.

**Deadlines:**

17: March 4, 1994

The SEG Newsletter is published quarterly in January, April, July and October by the Society of Economic Geologists, Littleton, Colorado, exclusively for members of the Society. Opinions expressed herein are those of the writers and do not necessarily represent official positions of the Society of Economic Geologists. When quoting material from the SEG Newsletter please credit both author and publication.

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**INFORMATION FOR CONTRIBUTORS**

The SEG Newsletter is published for the benefit of the worldwide membership of the Society of Economic Geologists. We invite news items and short articles on topics of current interest to the membership. Exploration news should be directed to the appropriate Regional Editor. The FORUM is for commentary and exchange of ideas on matters of concern to economic geologists; however, please note that discussion of articles in Economic Geology should be directed to that journal, not to this Newsletter. If you have questions on submission of material, please call the Editor at 303-988-1124 or FAX details to 303-988-1124.

**Format:** Manuscripts should be double-spaced. If possible, please submit paper copy and a computer diskette in either DOS or Macintosh format, using Word or WordPerfect. Pertinent illustrations will be accepted in camera-ready form at publication scale. Authors are asked to obtain poor review of manuscripts to assure clarity and accuracy. 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 Secretary. Employment opportunities for economic geologists will be advertised free of charge.

**Deadline for Newsletter #17: March 4, 1994**
From the Executive Secretary

Following are the results of the 1993 election for Officers and Councilors of the Society: President-Elect—Brian J. Skinner; Vice President-Elect—Geoffrey G. Snow; Councilors—David W. Beatty, George H. Brimhall, Jr., and John F. Slack. All Regional Vice Presidents (listed on the back page of this issue) were re-elected for a further term of one-year. The terms for these newly elected officials will begin April 1, 1994.

In a separate letter ballot to all Fellows, the Constitutional Amendment (described in this column in the October issue) was approved by a wide margin; only a very few dissenting votes were received. Voter response was more than 40 percent of the full membership for the election and over 45 percent of the Fellowship for the Constitutional Amendment. These responses are significantly higher than previous years and indicate increasing participation of the membership in the affairs of the Society. Clearly a good sign.

At the GSA meeting in Boston, total registration approached 6,400—the best since GSA’s Centennial in Denver, 1988. The SEG technical programs and field trips were well-attended and well-received. Again, the Society is indebted to those responsible for the success of these well-organized activities: Program Chair Hal Zantop, and field trip organizers Erich U. Petersen and John F. Slack, together with their co-workers. At the SEG luncheon, Douglas W. Haynes of Western Mining Corp. and Naomi Oreskes of Dartmouth were recognized as Distinguished Lecturer and Lindgren Award recipient, respectively. Coincidentally, both are involved in geologic studies of the mammoth Olympic Dam deposit in South Australia.

Although a Council meeting was not convened at Boston, the Executive Committee met twice and worked through a full agenda, including: (1) initial planning for the next SEG “stand alone” meeting; (2) participation with GSA at a forthcoming meeting in Prague, where Prof. R. Stumpf will organize two symposia and a field trip to the Polish Kupferschiefer on behalf of SEG; (3) SEG participation in future meetings, conferences, and field trips in Europe and elsewhere; (4) the appointment of an ad hoc committee (B. Bouley, G. A. Barber and D. F. Sangster) to review previous efforts to address problems of expansion of the Society into those countries where local economics render the cost of membership prohibitively expensive, and to bring specific recommendations to the Albuquerque meeting; (5) approval in principal for a (combined) student chapter in South Africa recommended and sponsored by W.E.L. Minier, and (6) consideration of the in-depth report submitted by the ad hoc Publication Review Committee (D. M. Davidson, Jr., J. R. Craig and W. P. Pratt) and implementation of the resulting recommendations. Publications are an increasingly important activity of the Society and a very significant source of revenue; some restructuring of the way we go about this business is being undertaken more about this later.

The Finance, Research, Funding Priority, Student Affairs and Program Policy Committees also held productive meetings in Boston. The Program Policy Committee, chaired by Vice President Phil Bethke, emerged from one of its typical evening marathon sessions with a number of exciting programs, foremost of which is the International MVT Field Conference to be held in 1995, SEG’s 75th anniversary year. Marty Goldhaber of the U.S.G.S. is undertaking the organization and coordination of this ambitious event with field trips and symposium being scheduled in Ireland, U.S.A. (St. Louis) and Australia. Preliminary announcement is elsewhere in this Newsletter, with details to follow in the near future.

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COMMON CENTS

I am pleased to report that the efforts of the Membership Committee, chaired by Bruce Bouley, have yielded significant results as may be observed below. This increase in membership, together with the success of the Denver meeting last April, leaves the Society’s operations in very sound financial shape as we enter 1994. That our diverse publication ventures are also financially successful (thanks in no small part to substantial SEG Foundation support for this Newsletter) is icing on the cake. I hope to provide a detailed analysis for all three entities (SEG, SEGf and PUBCO) following the January audit. Best for the New Year! 

— Don Davidson, SEG Treasurer

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SEG MEMBERSHIP 1968-1993

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PRESIDENTIAL PERSPECTIVE

SEG International

As I prepare this column in Jakarta, I am more deeply impressed than ever with SEG's international opportunities and responsibilities. Not only are mineral deposits indiscriminately international, but so are the mining industry, creative exploration programs, centers of scientific excellence and so forth. The great discoveries, new mines and research breakthroughs of recent decades have shown no national limits, and many of the teams were international! All evidence suggests this internationalization will continue. So where does SEG fit into all this?

The Society's mission has always been to promote the science of mineral deposits, and promote the application of that science to industry, everywhere. The Bulletin has always carried articles on world-wide topics. However, only in recent years have the real challenges of a truly international Society become apparent. Following establishment of the VP for International Affairs and the Regional VPs, the International Lectureship was initiated. We held our first major international meeting with GAC-MAC in Canada two years ago. The Integrated Exploration Symposium in Denver in 1993 included at least 25% of the participants from other countries. This is progress, but many challenges remain.

Issues such as more broadly distributed locations for international symposia; joint field trips with other societies; access to mineral deposit descriptions where language and nationality are barriers; memberships for geologists in countries where currencies make membership dues prohibitively expensive; access to the Bulletin and SEG publications in remote parts of the world where geologists tend to congregate; and globe-trotting short courses are all very real. What do geologists of the international mineral deposit community want and need? How does it differ from their colleagues in urban areas with access to libraries, government surveys and universities? Where could SEG fit into all this?

To help move us along this path of internationalization, I appointed an ad hoc committee to review our status, identify opportunities and make recommendations at the society meetings in Albuquerque, NM in February, 1994. If you have suggestions contact committee members Bruce Bouley (Chair), Don Sangster, Art Barber, or me. At the same meetings, recommendations related to publications and the report of the ad hoc publications committee will be considered.

In response to my column on mineral deposit models in the last Newsletter, I received a thoughtful letter from Jeff Hedengquist. He suggested we try a column on mineral deposit models in the Newsletter as a first start, and that is under consideration. Thanks, Jeff!

In the spirit of contributions that appear elsewhere in this issue of the Newsletter, I finish with a thought. SEG's mission is to promote science and its application; science is an essential beginning, successfully applied technology is an ultimate goal! Our full mission is realized when we organize our scientific and technical discoveries to discover ore!

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Environmental Geology Models of Mineral Deposits

Geoff Plumlee (SEG '90)

Geologic Controls on the Environmental Effects of Mineral Deposits

Mineral deposits, although complex, can readily be classified according to similarities in their geologic characteristics and modes of formation. The same geologic characteristics that distinguish different mineral deposit types also result in characteristic environmental signatures. These signatures occur prior to mining or as a result of mining and mineral processing. Along with geochemical processes (such as sorption, mineral precipitation/dissolution, and evaporation) and biologically mediated processes (such as bacterial iron oxidation), mineral deposit geology is a fundamental control on how mineral deposits and mineral processing byproducts interact with the environment. Other important controls, such as climate, topographic setting, and mining and mineral processing methods, generally modify the environmental effects mandated by mineral deposit geology and geochemical processes.

A study of mine waters draining diverse mineral deposit types (Figure 1) illustrates that environmental signatures are a readily predictable function of mineral deposit geology, geochemical processes, climate and mining method. Waters flowing through pyrite-rich massive sulfide ore bodies develop some of the most acidic and metaliferous mine drainage compositions measured worldwide; these compositions reflect (1) the lack of acid buffering capacity in their wallrocks, (2) focused flow of groundwaters within massive sulfide lenses, and (3) heat generated during sulfide oxidation and the resulting evaporation of groundwaters in underground mine workings (data and interpretations for Iron Mountain, California, from C. A. Alpers and K. Nordstrom). Pyrite- and enargite-rich ores in advanced argillitically altered wallrocks (such as quartz-aluminate deposits at Summitville, Colorado, and Cordilleran lode deposits at Butte, Montana) have extreme acid generating capacity but negligible acid buffering capacity. They therefore produce highly acidic waters with extreme concentrations of copper, zinc, arsenic, uranium, chromium, rare earth elements and other elements. In contrast, polymetallic ores that are carbonate-rich, are hosted by carbonate-rich sediments, or occur in propylitized wallrock (green is good!) most often generate waters with near neutral to alkaline pH values, and if pyrite-rich, these ores can create drainage waters with significant quantities of dissolved zinc. Trace metal concentrations in drainage waters are also readily predictable. For example, waters draining rocks from the lead- and zinc-poor central portions of Climax-type porphyry Mo systems can have pH values below 2 but relatively low total dissolved base metal contents; however, these waters contain extremely high dissolved fluoride concentrations (as high as 700 ppm), due to abundant fluorate in the deposits, and high dissolved uranium concentrations (as high as 10 ppm), due to the uranium-enriched host rocks and the formation of uranyl-fluoride complexes.

Environmental-geology Models of Mineral Deposits

The mine drainage data discussed above, although still being updated to include additional deposit types, climate zones, etc.,
show that general environmental geology models of mineral deposit types can be developed successfully. Prototypes of such models are currently under development at the U. S. Geological Survey, Office of Mineral Resources. For given deposit types, these models summarize environmentally pertinent geologic information such as: ore, gangue, wallrock and alteration mineralogy (acid generating vs. acid consuming, etc.); secondary oxidation mineralogy (soluble vs. nonsoluble); geologic controls on permeability, groundwater flow and oxidation; and other deposit types with similar environmental geology characteristics. These models also provide available empirical data on environmental signatures that: (1) are present prior to mining in soils, stream sediments, and ground and surface waters (exploration geochemistry data); (2) result from mining and mineral processing (mine drainage waters, mine wastes, mill tailings and tailings waters, and heap leach solutions); and (3) result from smelting (smelter slag and stack emissions). The environmental signatures include information on the suites and likely concentration ranges of elements in waters, wastes, soils, etc., and the ease with which the elements can be liberated into the environment (their "geoavailability," as termed by Warren Day, USGS). For deposit types for which empirical data from existing sites are lacking, potential environmental signatures can be extrapolated from similar deposits for which data are available.

**Potential Uses of Environmental-geology Models**

**Prediction and mitigation:** Following the old adage "an ounce of prevention is worth a pound of cure," environmental models can be used by industry, land managers and regulators to help better predict and plan for potential environmental effects that would result from the development of specific mineral deposits. For example, future development of quartz-alunite and similar deposit types should take into account the likely occurrence of highly acidic, metalliferous mine waters; development of deposits of this type might therefore be more viable environmentally and economically either in arid regions or in areas with abundant nearby acid consuming materials such as carbonate sediments.

**Remediation:** There is increasing recognition that to clean up all environmentally hazardous mine sites to pristine conditions is neither economically viable nor feasible. Instead, more cleanups in the future will be carried out to baseline conditions that existed prior to mining. Exploration geochemists have recognized that information on pre-mining signatures contained in the models can be used to help establish geologically and geochemically reasonable baselines and remediation standards for specific deposit types in specific climates and geologic environments. The models also provide land managers with a low-cost screening technique to help identify, prioritize for study and remediate hazardous mine sites on public lands. Examples of the models and their uses will be presented at the upcoming USGS V. E. McKelvey Forum on Mineral Resources in Tucson, Arizona, February 22-25, 1994.

**Summary**

Geologic information can and should play an important role in the environmental aspects of mineral resource development. Using environmental geology models of mineral deposits, geologic information can be organized and utilized to maximum benefit by economic geologists, industry planners, regulators and land managers. Environmental modeling of mineral deposits is still in its infancy. Any comments, thoughts, or suggestions are welcomed.

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**COLUMN EDITOR:** Geoff Plumlee, U. S. Geological Survey, MS 973 • Federal Center, Denver, Colorado, 80225, USA. Phone (303) 236-9224, FAX (303) 236-3200.
The tungsten and molybdenum deposits are associated both with plutons that intruded the magmatic-arc and with the adjacent fold and fault belt terranes.

Eastern Uzbekistan and Kirghizistan are located within the high altitudes (up to 5600 m) of the Tian Shan Mountains, a composite of numerous individual ranges from NW China to central Uzbekistan separated by fertile valleys (Figure 2). Gold-bearing mineral deposits occur both along the margins of some valleys as well as in the rugged higher elevations. In contrast, the Tian Shan ranges in central Uzbekistan have much less relief, and the arid Kyzylkum Desert of this region is characterized by broad valleys with sparse vegetation.

This summary of selected gold-bearing mineral deposits of Uzbekistan is a brief guide to an important, but poorly publicized, region of gold metallogeny, with particular emphasis on the enormous gold resource at Muruntau.

**Figure 2.** Generalized geographic map of the western Tian Shan Mountains showing locations of principal mountain ranges and some ore deposits referred to in the text. The dark dashed lines show the approximate location of the suture zone, north of which are the remnants of the volcano-plutonic arc, and shelf, slope, and platform sedimentary rocks (diagonal lines). Selected regional shear zones are shown in lighter dashed lines.

**GEOLOGIC SETTING**

The late Paleozoic fold and fault belt of the Tian Shan in Kirghizistan and Uzbekistan hosts the major gold deposits of western Central Asia (Figure 2). This structurally complex Hercynian zone extends across the northern flank of the Alay and Turkestan ranges, bends to the NW across the NE flank of the northern Nurata Ridge, and then makes an arcuate bend to the NNW and back to the west in the northern Kyzylkum Desert. The zone is marked, from north to south, by the juxtaposition of a middle to late Paleozoic platform sequence, late Proterozoic to early Paleozoic oceanic sedimentary and volcanic rocks, and late Paleozoic melange and ophiolite. All three sequences are intruded by syntectonic alkaline to calc-alkaline intrusions. Closure of an ocean basin during the Hercynian resulted in the southward thrusting of the oceanic and platform rocks over previously (Caledonian) metamorphosed and deformed oceanic flysch, metavolcanic, and minor carbonate rocks. North of the suture zone are the remnants of the magmatic arc, which is best exposed in the Chatkal and Kuruma ranges southeast of Tashkent. In general, structurally deeper portions of the fore-arc region are exposed progressively to the south of the magmatic arc in the higher elevations of the Tian Shan and to the west in the Kyzylkum Desert.

**GOLD DEPOSITS WITHIN THE MAGMATIC ARC**

In western Kirghizistan and eastern Uzbekistan, Carboniferous calc-alkaline diorite to granodioritic magmas intruded continental platform sedimentary rocks, locally erupting through central vents to form andesite-dacite constructional volcanic edifices. Volcanic rocks host epithermal style veins at near the surface, whereas gold-bearing porphyry copper deposits were formed at depth.

The most significant porphyry system is the Kal'makyr deposit at Almalyk, Uzbekistan (Figure 2). Kal'makyr is the remnant of a volcano-plutonic center in which Middle Carboniferous diorite and syenodiorite were emplaced in Devonian carbonates. All of these rocks are intruded by upper Carboniferous granodiorite porphyry stocks and dikes (Samonov and Pozharisky, 1977) with associated andesitic-dacitic volcanic rocks. Gold is an important component of the copper-molybdenum porphyry-style ores and adjacent polymetallic replacement and skarn deposits, as well as small, epithermal-style veins peripheral to the porphyry center (Meshchaninov and Azin, 1973). Gold is associated with molybdenite, bornite and pyrite in the porphyry ores, and with quartz, carbonate, sphalerite, galena, telluride, chalcopyrite, pyrite and silver tellurides in the polymetamorphic ores (Zvezdov et al., 1993). Although higher grade, the epithermal veins are highly variable in thickness and irregular in extent along their strike and dip. Thus, they have been historically of less economic importance.

In the general vicinity of Kal’makyr, other volcano-plutonic centers are more completely preserved. In these, more productive epithermal gold-silver ores have been exploited. A few kilometers to the southeast of Almalyk is the Kauldy mine, an epithermal gold-silver vein system in andesitic lavas. The main ore mineral is electrum, which occurs with sparse pyrite in pod- and lens-like zones within banded quartz-calcite veins, with minor amounts of associated chalcopyrite, galena, and sphalerite. Deeper in the intrusive system are carbonate replacement deposits and porphyry copper-style mineralization.

East of Kal'makyr and south of Angren, Uzbekistan, is the large Kochbulak epithermal gold-silver deposit (Figure 2). This several million ounce gold deposit is hosted in andesitic to dacitic lavas, lahar, and
debris-flows and lacustrine tuffaceous sedimentary rocks. Although considered by our Russian colleagues to be a caldera sequence, we interpret the deposit to be related to a central-vent, constructional andesitic-dactic volcanic edifice. The extensively alunitized central-vent constitutes an aluminum resource. Northeast-striking, banded quartz veins feed upward into permeable lake sediments to form stratiform, lower grade deposits in the upper part of the vein system. At the NE end of the mineralization, large breccia pipes contain extremely high-grade gold ores. In contrast to Kaulky, veins at Kuchbugul contain 5-20% sulfides (Kurbagov et al., 1991). Metallic minerals include pyrite, telluride, native tellurium, native gold, electrum, galena, tetrahedrite and chalcocpyrite (Borodaevskaya and Rozhkov, 1977). The tellurides, most abundant in the breccia pipes, include petzite, altaite, sylvanite, calaverite and hessite. Less common minerals include argentite, sphalerite, arsenopyrite, huebnerite and bismuthinite. Gallium minerals include quartz, sericite, chlorite, calcite and barite.

Other epithermal-style gold deposits occur in this part of the arc. These include Chadak, Kyzylyama and Kairagach. The higher elevations of the Chatkal and Kuruma ranges are the best exposed part of the magmatic arc, possibly accounting for it also being historically the most productive part of the Hercynian magmatic arc.

The occurrence of gold-bearing, tungsten-rich ore deposits is also common in the Hercynian magmatic arc. At Kuchbugul, Borodaevskaya and Rozhkov (1977) report wolframite-quartz veins as an intermediate stage of mineralization. Anhydrite-molybdenite-wolframite-scheelite is reportedly a deep assemblage in the gold-bearing Dal'neye porphyry copper deposit adjacent to Kal'makyr (S. Diatchkov, written communication, 1993). South of Alamyk on the SW flank of the Kuruma Range, the Late Carboniferous-Early Permian Chorukhd-Dairon intrusive complex contains gold-bearing copper-molybdenum-tungsten garnet-scapolite-plagioclase skarns. Towards the crest of the range, gold-bearing lead-zinc polymetallic replacements of carbonate rocks at Kansay and Kurusay are associated with molybdenite, scheelite and bismuthinite mineralization at depth. In the Chatkal Range, NE of Alamyk, scheelite and gold occur in veins associated with quartz-sericite altered granitoids.

**GOLD-BEARING DEPOSITS OF THE FORE-ARC FOLD AND FAULT BELT**

The suture zone (Figure 2) with related faults on the south side of the volcano-plutonic arc is delimited by an alignment of ophiolite occurrences. The South Fergana fault zone in the north Alay and Turkestan ranges of the western Tian Shan is part of this zone which continues to the west as the North Nurata shear zone north of Samarkand. Farther NW, a number of shears splay off this zone, one of which is the Sangruntau-Tamdytau shear zone and the associated Dauzytau-Muruntau shear zone. From the Turkestan Range to the Tamdytau, these splaying shear zones are important controls on the most significant gold-rich ore fields known in Central Asia.

### The Muruntau Gold Deposit.

Located on the southeastern edge of the Tamdytau Mountains in the central Kyzzylkum Desert, with 40,000,000 ounces of past production and more than 100,000,000 ounces of reserves, Muruntau is one of the world’s largest gold mines and is the largest open-pit gold mine (Figure 3). The ore-bearing system is reported to stretch for about 20 km and to generally average 2-3 g Au/tonne. Nearby, much smaller and perhaps related ore bodies include Mutenba, Besopan, and Taskumyur deposits. Muruntau is hosted in the Ordovician-Silurian Besopan sequence of metapelites where it makes a z-shaped bend within the complex multi-strand, left-lateral Sangruntau-Tamdytau shear zone at its intersection with the Dauzytau-Muruntau shear zone (Figures 2, 3). The Sangruntau-Tamdytau zone trends subparallel to the range front just south of a Hercynian thrust that juxtaposes Devonian dolomitic limestones, melange, and ophiolite over both the Besopan and underlying late Proterozoic Taskazgan sequence. A variety of opinions exist about the geologic and structural setting of Muruntau and associated deposits, and we recommend referring to Kotov and Portitskaya (1992), Marakushiev and Khokhlov (1992), and Zaini and Kurbagov (1992) and included references for perspectives other than our own.

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2 As used in the Russian literature, “ore field” is a term referring to a group of deposits that share a common origin and continuity of structure (Guz'mov, 1970).
The Besopan sequence is subdivided into four units, bS14 (Kurbanov et al., 1991), with the three lowermost units generally metamorphosed to greenschist facies. The lowermost unit, bS1, is predominantly metasiltstone and is partly carbonaceous, whereas bS2 is predominantly metasandstone. Together, these units make up the “Gray Besopan.” Intermediate and siliceous volcanic fragmental material is found within these units (Marakushchev and Khokhlov, 1992). The major ore host in the region, bS3, is a composite section of predominantly carbonaceous metasiltstone, metasandstone, metavolcanic rock, and minor radiolarian chert. The volcanic rocks are predominantly intermediate and siliceous tuffs. This unit is carbonaceous and pyritic, and is referred to as the “Variegated Besopan” because of its red and green colors in outcrop. The “Green Besopan,” or bS4, consists of sandstones and siltstones with lenses of gritty sandstone.

Igneous dikes intrude the Muruntau ore field, primarily along the regional shear zones. Lamprophyric, alkaline, and granodioritic dikes have been reported (e.g., Kotov and Poritskaya, 1992). A pluton is inferred by some workers (cf. Kotov and Poritskaya, 1992) to occur at depth beneath Muruntau and adjacent Miutenbai, and be an extension of the porphyritic Sardarin pluton exposed about 7 km southeast of Muruntau.

Deformation prior to gold mineralization was important in developing high permeability within the Besopan sequence. Schistose and axial plane cleavage were developed during regional metamorphism and folding; these make up the primary permeability for the largest proportion of the mineralization.

Gold mineralization (Figure 4) occurred during the late Carboniferous to early Permian, at a time characterized by a change from compressional to transpressional tectonics. The major ore minerals—gold, pyrite and arsenopyrite—occur in association with quartz, ankeritic carbonate, phlogopite, K-feldspar and muscovite with accessoryapatite, monazite and TiO2 (brookite). Most of the gold is contained within low grade (2.5-3 g Au/t) “banded” and “stockwork” quartz veins. Such ores appear to be part of an extensive, gently dipping zone of small to microscopic quartz veinlets that have been mined presently down to a depth of more than 300 m. This huge veinlet system is recurrently cut by steeply dipping, thick and more continuous “Central Veins.”

We observed several alteration stages at Muruntau. Widespread albitization is the earliest alteration stage in the samples we collected, and appears to have been essentially pervasive within the ore deposit. The second stage of hydrothermal activity is defined by veinlets with predominantly phlogopite and some pyrite (± arsenopyrite), apatite, muscovite, quartz and K-feldspar. The muscovite, K-feldspar and quartz are primarily along vein selvages. Some magnesite, chlorite also is associated with the phlogopite. K-feldspar-quadrate-muscovite veinlets with ankeritic carbonate and sulfide cut the above veining, and represent a third stage of alteration. Although its paragenetic position is equivocal, a fourth event seems to be indicated by quartz-K-feldspar-tourmaline-carbonate-sulfide veinlets. This assemblage is observed cutting dikes and adjacent wallrock. The latest hydrothermal event in all rocks examined is represented by calcite plus a TiO2 phase (brookite?), both in veinlets and as a pervasive replacement of the metasedimentary rock. This alteration appears to be destructive of all preceding
alteration phases. Rare-earth minerals, including monazite and bastnaesite, occur in clusters in some calcite veins.

Geochemical analyses of the different mineralization styles indicate that gold may have been introduced with each of the four alteration assemblages mentioned above. In the Central Veins, we observed gold as inclusions within pyrite associated with ankeritic carbonate and arsenopyrite, and as isolated blebs in quartz. Sphalerite, galena and chalcopyrite occur as small grains or clusters of grains most easily observable in the Central Veins. Kurbanov et al. (1991) report that the deposit has anomalous concentrations of tungsten, bismuth, and molybdenum. More silver-rich mineralization occurs in ore bodies adjacent to the Muruntau mine, most notably to the west in the Kosmanachi deposit as well as in the Mutenbai deposit to the south. The mineralogy of this ore consists of pyrite, arsenopyrite, sphalerite, galena, freibergite, miargyrite, pyrrhotite, native silver and gold (Kurbanov et al., 1991).

Fluid-inclusion and stable-isotope studies of quartz veins are in progress. Microscopic examination of fluid inclusions provides evidence of fluid immiscibility in many quartz veins, with many gas-rich end members containing 80-100 volume percent vapor. To date, measurements have been made on inclusions from the earliest stage, ductilely deformed veins. These inclusions, ranging in diameter from 2 to 10 microns, have similar phase relations to those observed within later stockwork-like veins and Central Veins that were only 1-2 microns in diameter. For two-phase fluid inclusions with variable liquid-vapor ratios, most CO₂ melting temperatures range from -57.6 to -58.8°C, clathrate melting temperatures range between 6.2-8.6°C, and CO₂ homogenization temperatures range between 5.0-14.8°C. These data are typical of those reported for H₂O-C-N hydrothermal systems in metamorphic rocks. Thermally decrystallized inclusions were analyzed using a quadrupole mass spectrometer system. Data from an earliest stage vein and a Central Vein both indicated that the non-aqueous part of the ore fluids was made up of 50-80 mole percent CO₂ with the remainder consisting of roughly equal amounts of nitrogen and methane. Final homogenization temperatures in the early stage quartz generally range from 350-400°C, with homogenizations taking place into both the liquid and vapor phases.

Preliminary stable-isotope data have been obtained from some of the different vein sets at Muruntau. Values of δ¹⁸Oₓₒₓ range from +15‰ for the earliest stage quartz veins, to +7.8‰ for the stockwork-like veins, to +12.3 to +13.1‰ for the Central Veins. Assuming formation of all veins at 400°C, the δ¹⁸Ofluid would be approximately +4 to +9‰. The relatively wide range for fluid values may reflect variable water-rock situations, mixing of different fluids in some structures, or an erroneous assumption of uniform formation temperatures. Values of δD of -79‰ and -97‰ were obtained for fluid inclusion waters from the Central Vein and earliest stage quartz, respectively. Sulfur isotope analyses on pyrite and arsenopyrite from a Central Vein and stockwork-like quartz range from +2.8 to +5.5‰.

The chemistry of the ore fluid volatiles appears to be similar to that of other mesothermal gold deposits. However, homogenization temperatures are about 50°C hotter than those of typical Archean deposits and 100°C hotter than those from most Phanerozoic deposits.

Other Gold-bearing Systems. Syntectonic, shear-zone hosted auriferous mercury-, antimony- and arsenic-rich mineral occurrences are widespread in the Hercynian fold and fault belt of Kazakhstan and western Uzbekistan. Host rocks include Devonian-Carboniferous carbonates and Silurian-Carboniferous carbonaceous silicilastics. With P-T conditions for vein formation ranging from 60° to 250°C and 2-3 Kba (Isanov and Korsak, 1991), these deposits are stated to represent a continuum of crustal mineral deposition from relatively deep Archean systems to near-surface Hg-rich systems. The former also often contain anomalously Sb, F and sometimes Au; the latter anomalous Sb, Cu, Pb, Zn, W and generally Au. In the Hg systems, the principal ore minerals are cinnabar and stibnite in quartz-calcite veins. The mercury deposits are normally concentrated across the northern end of the fold and fault belt, suggesting more shallowly exposed rocks closer to the arc. The principal ore minerals in the Archean gold deposits are pyrite, arsenopyrite, stibnite and gold, with lesser chalcopyrite, sphalerite and local galena, tungsten-, molybdenum- and bismuth-bearing minerals. Gangue consists of quartz, carbonates, sericite, and some barite and fluorite (e.g., Isanov and Korsak, 1991). There are many localities in the western Tian Shan Mountains—Alay, Tuyuzistan, Zirabaluk ranges—that contain such deposits and occurrences (e.g., Chalkyryk-Askudilgin district).

Deeper levels in the fold and fault belt occur in the northern Nuratau Range, where strata are boudinaged within major shear zones (Akhber and Mushkin, 1976). The Zarmitan ore field (Figure 2) occurs within this zone, and consists of a series of fault-controlled NNW-striking gold-bearing crack-seal veins. These Mother Lode-like quartz veins contain pyrite, arsenopyrite and ankeritic carbonate with minor amounts of tungsten-, bismuth-, lead-, zinc- and antimony-bearing sulfides.

The Daugyztau and Amentaitau ore fields (Figure 2) are in the deformed metapelites of the Beltau Mountains and Daugyztau massif, several tens of kilometers SW of Muruntau along the Daugyztau-Muruntau fault zone. Auriferous veins in both ore fields look like typical mesothermal vein systems. Veins show evidence of both brittle and ductile deformation. They are commonly mylonitized, show ribbon structure, and contain highly sulfidized breccia fragments. All veins are localized with the ENE-striking regional shear zone near its intersection with a NNW-trending zone of shearing parallel to fold axes in the region. The ores occur predominantly in large veins along steeply dipping NNE and NE fractures. However, in the northern Daugyztau ore field, where the NNW and ENE shear zones intersect, more stockwork-like ores are present. Gold occurs predominantly with pyrite, arsenopyrite, minor stibnite and silver sulfosalts, and ankeritic carbonate. Wall rock alteration (Kurbanov et al., 1991) consists of early albization, then quartz,
chlorite, muscovite and ankeritic carbonate, and a final stage of carbonate alteration. Gold also occurs in silver-rich ores in association with lead and antimony sulfosalt. The Vysokovolynko deposit at the southern end of the Daughzytay ore field contains bonanza-grade silver-lead-antimony-gold ores in mesothermal veins.

Syn-kinematic granitic intrusions into the Hercynian fold and fault belt have produced a large number of tungsten-molybdenum-gold occurrences along the length of the Tian Shan. In the Buktaun region (Figure 2) of the central Kyrgyz Republic, the Sary-Tau-Turba mine field contains gold-bearing copper-molybdenum-tungsten skarn and quartz-scheelite vein ores. The skarns occur in dolomites and calcareous silicates at the contact of a Late Carboniferous-Early Permian intrusion, the Sarytau massif. The mineralization consists of scheelite, molybdenite, pyrite, arsenopyrite, chalcopyrite, bismuthinite, native gold and galena; and minor sphalerite, tetrahedrite-tennantite. The gangue mineralogy includes quartz, K-feldspar, calcite, epidote, chlorite and sericite.

Within the overthrust terrane in the Buktaun region, massive sulfide ores occur in the Kokpatau ore field just south of the magmatic arc. Highly schistose, mafic to intermediate volcanic and volcaniclastic rocks are thrust over Devonian-Carboniferous platform carbonate rocks. Within the volcanic sequence are stratiform, massive pyrite lenses underlain by structurally controlled stockwork-like vein zones. The deposits are small, but numerous. Gold occurs in the veins in association with pyrite and arsenopyrite. Alteration minerals include quartz, sericite, fuchsite, chlorite, and Mg-Fe carbonates. It is uncertain whether some ores are partly syngenetic or whether they all reflect Hercynian epigenetic hydrothermal activity.

CONCLUSIONS

The late Paleozoic was a time of extensive gold mineralization throughout the northwestern and western ranges of the Tian Shan Mountains of Central Asia. Island-arc related volcanic-plutonic activity resulted in gold-bearing porphyry, skarn, polymetallic, and epithermal vein deposits. During plate-tectonic suturing, mesozonal synkinematic, shear-zone hosted deposits were formed, one of which, Muruntu, is the world's largest open-pit gold mine. Regionally extensive anomalous gold in rocks of the wide desert basins of central and northern Uzbekistan and shallower structural levels in the fold and thrust belt of the western Tian Shan ranges of eastern Uzbekistan and western Kirghizstan indicate considerable gold resource potential remains in this region.

ACKNOWLEDGMENTS

It would not have been possible for us to gather the aforementioned information without the generous help, insights, and publications of colleagues in Russia and Uzbekistan. To them we owe a great deal of thanks. The USGS has also been very supportive, providing not only time and resources for our trip, but also allowing us to pursue an understanding of the deposits.
NEWSLETTER EDITOR'S NOTE: Based upon comments and contributions of a number of SEG members, it appears that some differences of opinion exist regarding the respective roles of the SEG Newsletter and Economic Geology and the Bulletin of the Society of Economic Geologists. In an attempt to clarify the respective roles of these publications, two articles of editorial policy are printed below. I am grateful to Dr. Brian J. Skinner for graciously accepting the invitation to write about Economic Geology. I thank Dr. John A. Thom for supplying the additional article about advertising policy for the SEG Newsletter.

**SEG Newsletter:**
Policy and Practices that Guide the Editor

Holly L.O. Huyck, Editor SEG Newsletter

The first SEG Newsletter was published in April, 1990. In almost four years, this publication has evolved in length and content, but, as it is still young, its policy has not been delineated as formally as the Bulletin.

My predecessor, Alan Wallace, concisely summarized the Newsletter's goals: (1) to serve as the voice of SEG by announcing SEG-related activities and information, (2) to provide a broad international summary of the economic geology community activities and (3) to be timely.

Achieving these goals requires delicate balancing on the part of the editor. Newsletter articles by various society officers, including regional vice presidents, provide information about both activities and concerns of the society. The Newsletter is purposely informal to encourage lively exchange of ideas. Letters to the Editor and Reports on Forums are intended to invite responses.

Both the technical lead article and the exploration reviews offer information about activities around the world. The technical report is oriented towards either field observations or, in exceptional cases, exploration techniques, and must be concise. Original observations must comprise a substantial portion of the paper. Authors are expected to have their paper peer reviewed prior to submission to the Newsletter, but the Ore Deposits Editor, John Wilson, and the Editor review contributions and may obtain further outside review. The review to publication time usually takes 3-6 months. Despite fairly rapid turnaround, the Newsletter strives for high technical standards in its lead article. Priority is given to articles that include a large component of descriptive field relations and focus on exploration-related topics.

Exploration reviews provide professional information about industry activities worldwide. As international activity and membership increase, Co-editor, Richard Grauch, continues to expand the distribution of reporters. Reporters have been given relative freedom to state their opinions, except for incendiary comments. We continue to seek balance in this regard (See Letters to the Editor.)

The Newsletter is becoming a victim of its growing popularity. Contributions greatly

**economic Geology:**
Policy and Practices that Guide the Editor

Brian J. Skinner, Editor Economic Geology

When the founders of Economic Geology met in Washington, D.C., on May 16, 1905, to form a not-for-profit company in order to publish a new journal, they knew precisely the role they wished the journal to play. The company they formed, the Economic Geology Publishing Company, known colloquially as PUBCO, continues to own and publish Economic Geology, and continues to be guided by their wishes, which are embodied in their 89-year-old statement of purpose. The journal of Economic Geology, they wrote, "will be devoted primarily to the broad application of geological principles to mineral deposits of economic value, to the scientific description of such deposits, and particularly to the physical and structural problems bearing on their genesis." To make sure that successors did not thwart their intentions the founders went one step further and stated specifically what the journal would not do: "With the engineering and commercial aspects of mining, Economic Geology will not be directly concerned." Those two statements of purpose define the editorial policy under which Economic Geology has operated from the day of the first issue to the present.

Through their choice of name, the founders provided additional guidance to their plans for the new journal. The original name choice, the Journal of Applied Geology, was eventually judged to be misleading, and Economic Geology was selected instead. The term "economic geology" did not originate with the founders of the journal. It originated, so far as I know, in the 1830s in England, as the name of a museum devoted to the study of the origins of geological materials that can be profitably utilized by society and, more specifically, to the application of science to the understanding of the occurrence of mineral deposits. It is quite clear from the choice of name and the statement of purpose that the founders meant the journal to be devoted to economic geology as the term was then understood and not to the economics of geology or the economics of geologic materials.

The affairs of PUBCO and therefore of Economic Geology are overseen by the
exceed available space. I have already pushed the limits of length; the 1992
limits set were 24 pages of text plus advertising; the last issue that short was
January, 1993. So, standard editorial practice is to request strict length limits
for articles (other than exploration reviews). Many enticing ideas for articles
either wait for space or result in half the size that the author had planned;
others require too much space to be included. This frustrates some, but
results in crisp, readable articles. ("Be concise! Waste nothing!"—Strunk and
White's "Elements of Style")

Other regular columns in the Newsletter, such as Economic Geology and
the Environment, and Publications of Interest, are for the society's
information. Society announcements notify members of upcoming events,
and short summaries of activities keep members informed about events that
they have not attended.

There are a few items that the Newsletter is NOT. It is not "a publication
of last resort"—high standards are maintained for technical papers. The
calendar announces upcoming events of interest to members, but the
Newsletter does not guarantee space for any free announcement. (See
Newsletter Advertising Policy.) The Newsletter is not a regional journal. With
so many international contributions, it is now limited to events of national or
international interest.

The SEG Newsletter is a timely publication, which depends upon the
prompt arrival of reports from many volunteer authors, the efficiency of
each member, and rapid turnaround by layout, printing and mailing companies.
A break in any one of these links affects all others. Arrival of the Newsletter
is a much-anticipated event; any slowness in delivery generates a flurry of
phone calls from concerned members. We will continue to meet deadlines
as closely as possible, even if it means deferring late arrivals to the next
issue.

The Newsletter is a service to SEG members. It has flexibility to present
discussions that might not appear in a more formal venue. It has the capacity
to experiment, then ask for a response. It also has a responsibility to present
varied opinions. An editorial in a Denver newspaper recently made an
excellent point: "There is a critical difference between editing and
censorship." We will continue to publish varied opinions, but will remain
mindful of the sensitivities of our members. Letters to the Editor, such as
those in this issue, remind us to maintain a balance of both topics and
perspectives.

In short, the editorial policy of the Newsletter is to seek balance between
scientific and professional needs, between society news and general
information, and between spontaneity and formality. Just as Economic
Geology is balanced towards scientific interests, without compromising
professional standards, so the SEG Newsletter "balance" tips towards
professional interests, without compromising scientific standards.

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SEG Newsletter
Advertising Policy

John A. Thoms, SEG Executive Secretary

Most of you have probably noticed the increased level of
advertising in the SEG Newsletter over the past year. The
Newsletter is fortunate in having attracted a strong level of
advertising support. Of course, this says something about the
Newsletter and how it is perceived by our advertisers. However,
the success of the Newsletter and the corresponding increase in
advertising has generated something of a dilemma. Current
advertising revenues cover approximately 75% of Newsletter
costs. Further increases in advertising will necessitate an
expanded Newsletter in order for the editor to maintain a
reasonable ratio between news and advertising. An expanded
Newsletter means increased mailing costs. After printing, mailing
(to over 3000 members) is the single largest cost in producing
the Newsletter. Maintaining the Newsletter at its current size
and balance between news and advertising requires that all
advertising be revenue-generating ("paid advertising"). The
Newsletter does occasionally accept unpaid advertisements when
the potential benefit to members is judged to offset the lost
revenue. Advertisement of employment opportunities would be
an example. The Newsletter receives many requests to advertise
short courses, conferences, seminars and similar activities
sponsored by other organizations. Even though the sponsors
usually are non-profit organizations, registration or other fees
are charged, and a positive financial return is expected. The
Newsletter does not accept non-paid advertising for these types
of (non-SEG) activities. The Newsletter will, however, include
short announcements in the "Calendar" section, or elsewhere as
appropriate, when space is available. Nor does the Newsletter
participate in (non-paid) reciprocal advertising with other
publishers unless there would be a significant benefit to the
Society, such as reaching a broader market for SEG activities
(conferences, field trips, etc.), for publication sales, or for
increasing membership. The reciprocal advertising opportunities
presented thus far have fallen short of these criteria. The SEG
Council has mandated that the Newsletter should attain self-
sufficiency, although a firm time-table to do so has not been
established. The Newsletter is provided free of charge to all SEG
members; no portion of an SEG member's dues is allotted to
cover any cost of the Newsletter. Also, the Newsletter is unique
among SEG publications in that it is available only to members,
and so does not generate income from additional subscriptions,
other than from a very few libraries. To reach self-sufficiency,
the Newsletter has to depend on advertising. The bottom line
here is that space available for advertising in the SEG Newsletter
must be revenue-generating.

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For inquiries about receiving your Newsletter, or about
Newsletter advertising, please contact:  JOHN A. THOMS,
SEG Executive Secretary, Society of Economic Geologists,
5808 South Rapp Street, Littleton, CO 80120; tel. 303-
797-0332, FAX 303-797-0417.
Board of Directors of the Economic Geology Publishing Company. One of the issues that must have been debated at length by its Directors when the Society of Economic Geologists was founded in 1920 was the relationship between PUBCO and its new young relative SEG. Many of the same people who founded PUBCO were also involved in the founding of SEG, yet the two organizations have been maintained as separate entities. The membership of SEG makes known its interests and concerns about the activities of PUBCO through the Board of Directors of PUBCO, which includes the President of SEG (who is also a member of PUBCO's Executive Committee) and several members nominated by the SEG Council. The Directors of PUBCO, as successors to the founders, can, if they so choose, change the policy of Economic Geology in any way they see fit. They have never seen fit to change or overrule the wishes of the founders and so the original policy continues to guide the affairs of the journal.

In addition to the editorial policy, the activities of Economic Geology are directed by a body of editorial practices that has been developed over the years. The six principal tenets of editorial practice are:

1. The journal is devoted to the publication of papers presenting original research.
2. All papers must be submitted in English and, if accepted, be published in English.
3. Papers must be original. Duplicate publication, even in another language and/or a venue of difficult access, is not acceptable.
4. All papers are to be peer reviewed. The mechanism for seeking peer reviews has varied through the years, but at present it is handled through an Editorial Board whose members seek reviews. The opinions of two or more technical experts are sought. In the case of regular papers, while one review is sufficient for scientific communications. One or more members of the Editorial Board, in addition to the Editor, read each paper, and the technical reviews.
5. Authors can be encouraged to submit papers for potential publication but authors cannot be asked to write nor can authors be promised publication prior to review.
6. Discussion of a paper previously published in Economic Geology can be accepted and published without review at the Editor's discretion, but such discussions must be confined solely to material in the original paper and cannot be used to introduce new material that has not been peer reviewed. Where doubts as to the appropriateness of a discussion arise, outside review opinions are sought.

Topics of papers submitted to the journal are governed to a large extent by research activities in economic geology. You will note in the statement of practices that nothing appears concerning topics. There, the statement of the founders serves for guidance. However, the tenets of practice decree that the journal only publish papers that are submitted. If there are topics on which papers are not submitted then such topics do not appear in the journal even though they may be welcomed by readers. There are several obvious examples—papers on industrial minerals and coal are infrequent in Economic Geology, as are the kind of detailed field studies of individual mineral deposits which were staples in the journal a half-century ago. Such gaps in publication do not arise because policy is against the topic or because the Editor and the Editorial Board are opposed, but rather because such papers tend to go to specific topic journals and are rarely submitted to Economic Geology as a result. To some extent it is possible to fill the gaps by publishing special topic issues, but such efforts produce only minimal change at best in the direction and momentum of research in the field. The papers that the journal receives are an index to current research in the field of economic geology. It is interesting to look back through the years and see how widely the research pendulum has swung from time to time.

In addition to adhering to policy and maintaining practices, an editor exerts influence in many ways—by choice of the editorial board, for example, by choice of which paper is sent to which board member, by selection of reviewers and, most importantly, by insisting that authors adhere to standards of quality. An editor also plays an indirect role in the development of research in the field as a whole by seeing that a journal is an effective, reliable, and responsible medium through which workers can communicate without fear that their findings will be deliberately pre-empted or distorted in presentation.
on the last day of the SEG '93 conference in Denver, interested parties gathered for a forum on assaying and geochemical analysis. The forum was titled "Assays, Conflict Between Quality and Cost." Forum members presented their views regarding the importance of quality assay work and discussed costs that arise when a mistake occurs.

Laboratory errors and mistakes cost a lot of money. In order to minimize the problem, you should practice the following when dealing with the laboratory you use: 1) communicate with the laboratory, 2) know the methods and operating philosophies of the laboratory, 3) submit blind quality control (QC) samples, and 4) use two laboratories, one for the sample preparation and one for the analytical work.

Mary Doherty, Chief Geologist at Big Springs, Independence Mining Co., said that operating philosophies and layouts of laboratories vary widely. In order to minimize human error, trained personnel are essential. Data reporting procedures should be examined, as mistakes are common there. Communication with a person doing the work in the lab, and openness and honesty in analytical procedures are also extremely important in order to avoid costly mistakes.

Mary gave two good examples of how laboratory problems cost a company a significant amount of money. A high grade gossan contaminated soil samples in a prep facility, causing $28,000 to be wasted on drilling a false soil anomaly. Bad classification of ore due to lab errors cost a mine $50,000. Mary prefers to use a reputable laboratory. She believes that "You get what you pay for."

Bob Gerteis, laboratory manager for XRL in Golden, Colorado, stated the importance of 1) well-trained technicians, 2) use of published analytical methods, 3) use of proper quality control procedures, 4) vigilant management, and 5) an organized and clean facility. Geologists should understand the methods used by laboratories. Bob said that work should be done at a price that is fair for both the geologist and the laboratory.

Jim Cardwell, president of Rocky Mountain Geochemical in Salt Lake City, noted that price wars among analytical laboratories have caused the failure of some commercial labs. The real failure, however, the quality of analytical work, has occurred because the downward cost pressure affects the quality of personnel. It takes a long time to recognize poor data. Many methods used by laboratories are bad, and some laboratories are even incompetent or fraudulent. Jim maintained that the fault often lies with geologists who do not communicate with their labs. In order to avoid such problems, the geologist needs to get involved with and to know his or her laboratory. A geologist should always submit QC samples to the lab. A good laboratory will always try to solve a problem and make things right. Jim suggested that a geologist use two good labs, one for the bulk of the work and one for check samples.

Borden Putnam, with Mineral Resource Development in San Mateo, California, talked about setting up the quality control program for a now-defunct commercial laboratory. Lack of quality control is both the lab's and the geologist's problem. The geologist needs a way to know when a lab is out of control. Borden suggested that the geologist tour the laboratory, showing up unannounced, preferably at the worst possible time for the lab.

Geologic audits show that much ore reserve information is based on faulty assays. The assays are bad because the geologist is not willing to pay for a quality control program. Good, stable procedures in sample preparation are particularly important. Borden said that geochemical surveys are considered important by leaders in the mineral exploration industry, so the quality of the geochemical and assay laboratories geologists use should be equally important. Data captured via modern should be verified, as it is sometimes unreliable.

Borden noted the importance of good precision and accuracy at the cut-off grade in a grade control situation. Laboratories cannot perform the QC function by themselves. They need input from geologists. Geologists should work with labs when they have a problem, and not simply move to another. Borden described a situation where two switched values directly cost a copper producer $37,000 by poor classification of a block of ore.

After members of the forum panel spoke, members of the audience made some excellent comments. Ed Post asked what people do with data from partial digestions. Jim Cardwell thought that such data can be more easily manipulated because it is so cheap. In reaction to Jim's comment, Barry Smeed stated that partial digestions are excellent for exploration work, but one must realize that accuracy has no importance in the generation of such data, and that precision is everything. Duplicates submitted by the client become a very important part of the QC process.

Lynda Bloom stated that selective extractions are a valuable tool in geochemistry. It is important to tie precision to the magnitude of the value of the metal, however, since precision decreases as the value of the metal approaches the detection limit.

Ian Robinson of CSIRO stated that research geochemists must take labs into their confidence. Sample preparation, especially proper clean-up between jobs, is
critical. The geologist should insert his or her own QC samples in every batch. Samples should be randomized in order to eliminate batch problems. Ian prefers an in-house sample preparation facility.

Borden Putnam responded that laboratories mix up samples enough without doing so on purpose. It is expensive to do and, if randomization must be done, the geologist should do it.

Nigel Radford agreed with Jim Cardwell that the geologist should submit QC samples in order to catch mistakes. He also advocated the randomization of samples to eliminate batch effects. Nigel stated that responsibility for the data rests ultimately with the project geologist and s/he must act on QC problems. He asked if North American laboratories report their QC's to the client.

Borden said that most labs will report QC's if asked, but most QC samples used by laboratories do not match the samples well. The geologist should send QC samples along with other samples sent to the lab and pay for their analysis. Steve Cone concurred, and added that laboratories cannot catch blank rocks submitted as QC samples, and the data from such a program is very useful in laboratory evaluation, especially in regard to contamination from sample preparation.

Stuart Robinson, of Mt. Isa Mines, reminded us to consider the quality of the sample, especially in regard to how representative the sample is.

Eric Hoffman, of Activation Labs, said that laboratories must assume that incoming pulps are QC samples. The only way the geologist can be assured that the QC's haven't been identified by the lab is to have the samples prepped and returned to the geologist. He can then submit QC samples on a blind basis with the rest of his samples.

Steve Cone stated that companies that have their own prep facilities have a distinct advantage in quality control, and that the control is worth the price of a prep facility.

Barry Smee said that a set of three QC samples cost $5000 to $7000 to make, including the initial analyses. Barry thought that two labs should be used, one for sample preparation and one for analysis. Thus, everything the analytical lab sees is a blind sample.

Jim Yeager, of Chemex Labs in Reno, said that the project geologist has responsibility for the quality of the data, which includes communication with the lab. Project geologists should not mix high grade samples in a batch with low grade samples. High grade samples should always be identified.

Harry Parker, of Mineral Resource Development, said that they find a lot of problems with analytical data in their review of mine related problems. Money spent on gasoline for free sample pick-up would be better spent on improving the quality of sample preparation. The geologist should directly control the sample preparation lab, and use a separate lab for assays. He recommended following this forum with a working party or short course on analytical procedures.

Ken Bright, of Bondar-Clegg, contended that the client-laboratory relationship should be a two-way street based on mutual trust instead of the adversarial relationships. Distortions in the bidding process often cause prices to be so low as to affect the quality of the data. He stated that establishment of trust and communication has its rewards.
EXPLORATION REVIEW

SOUTH AMERICA

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GENERAL

Exploration is accelerating as the South American summer swings into motion. As mentioned in the last Exploration Review, programs in the high Andes, Patagonia, throughout Peru, and elsewhere are well-funded by a mix of national and multinational companies.

Privatization of mining assets by the governments of Argentina, Peru and Chile moves forward, offering unique windows of opportunity to boost property portfolios of major and junior companies alike. These include the properties of Minero Peru, Centromin (Peru), CODELCO (Chile), and provincial mineral reserve areas in Santa Cruz, Chubut and San Juan, Argentina. Cyprus Minerals recently won bids for the world class El Abra copper deposit in northern Chile, as well as Cerro Verde, Peru.

CHILE

The biggest news from Chile relates to Cyprus Minerals/Lac Minerals' successful bid for 51% of the El Abra copper project, 40 km north of Chuquicamata. Of nine offers actually submitted, the Cyprus/Lac bid was significantly higher than the next: $404 million at closing plus $307 million in equity, which includes funding $151 million of Codeco's equity investment. Of this, $8 million is allocated to fund a technical drilling program to refine reserves. Development costs of oxide will require $1 billion total, including the mentioned equity and additional $700 million in funding. In addition, they have committed to fast-track a feasibility study by mid-1994. This is a huge investment (of similar magnitude to that required for Collahuasi) for arguably the largest remaining undeveloped copper asset in Chile (aside from Codelco mine properties), 405 million tons of 0.74% oxide Cu, amenable to leaching, and 607 million tons at 0.66% Cu of primary chalcopyrite-pyrite mineralization. Insiders have said the offer anticipates discovery of additional oxide and sulfide reserves.

Meanwhile work moves forward at Zaldívar, where Placer Dome's price tag of $100 million for 50% seems quite reasonable. Chile's national mining companies ENAMI and Codelco offered a new package of copper, gold and silver prospects for privatization: Guacazul, 90 km from Chuquicamata (Cu); El Inca, 16 km northeast of Chuquicamata (Ag); Brecha Esmeralda, 55 km from Chacaral, and La Polola, 18 km from Inca de Oro (Cu). At this writing, the successful bidders had not yet been announced. Bids for ENAMI's Altamira copper-silver property have been postponed until March, 1994. Twenty-two companies of all sizes pre-qualified in September to present offers for the undeveloped deposit in the north coast range which hosts 12 million tons of 1.75% Cu with 40 g/t silver.

The copper-oxide SXEW projects, Leonor and Tesoro, located south of Calama may be jointly developed by Equatorial Gold and Minera Anaconda Chile (Lyksik Group), providing a mutually acceptable operating agreement can be reached. Equatorial's smaller Leonor deposit (24 Mt at 1.6% Cu) cannot stand alone at current copper prices ($75c/lb), and Lyksik has time, money and 66 million tons (at +1% Cu) on its side, while both parties want operatorship. Leonor's revised feasibility study should be completed by year-end. Placer Dome dropped its option to control Leonor earlier this year because of difficulty in reaching agreement with Anaconda.

Low-key activity continues in the Maricunga Belt, best known as a new district of gold-silver discoveries made by Anglo/Cominco in the early 1980s. At Aldebaran, a vertically exposed, large low-grade copper-porphyry target at +4500m elevation, Arizona Star (Bema Gold) announced positive results of a 20,000 m RC drilling program and pre-feasibility study which estimates an 81 million ton reserve at 0.65 g/t gold (0.021 oz/ton). Cominco initiated sale of 50% interest in the neighboring Lobo deposit to Teck Resources for $1.5 million cash to total $51.8 million minimum purchase price. The Peña gold vein deposit was purchased by Eulogio Gordo, a Chilean investor who last year vended his interest in Guancoco to Amex Gold. La Peña contains 330,000 tons of 9 g/t in multiple veins, plus exploration potential. Codelco properties in the "Franja Aurrifera" optioned to third parties include the Cerro Coya gold property located near La Coipa to Santa Fe Pacific and Agua de la Falda to Homestake, located adjacent to its El Hueso gold mine. Cerro Coya represents the second Codelco property, besides El Abra, likely be developed by joint venture.

Dayton Mining announced it will proceed alone with development of the Andacollo gold deposit near La Serena, where feasibility studies show a mineable reserve of 32 million tons at 0.035 oz/ gold. Construction of the $60 million project to produce 100,000 to 125,000 oz/yr may begin in the second quarter of 1994. At the Mercedes prospect, an adjacent property previously drilled by Chevron, exploration by Minera Aurex Chile outlined six zones of disseminated gold mineralization with potential for 17 million tons at 1.38 g/t gold.

At El Indio, Lac Minerals is considering investment of $80 million to double gold production, currently estimated at approximately 197,000 oz for 1993. This includes expansion of the Tambo open-pit operation from 4800 tpd to 15,000 tpd, destined for an expanded plant/mill (6000 tpd) and heap leach (10,000 tpd) operation. Silver and gold production would be boosted, copper production would be unaffected, and El Indio would become the largest gold producer in South America. At the Tambo open pit, a preliminary minable reserve of 19.7 million tons grading 0.055
oz/ton Au has been outlined. Fifty km north of El Indio, at Nevada, Lac has identified a resource of 43.3 million tons at 0.077 oz/ton gold (3.3 million oz), and 50,000 meters of exploration drilling are planned this season.

In the post-El Abra era, Magma Copper is opening an office in Santiago. Companies active in gold exploration include Pegasus, Newcrest, Santa Fe, Newmont, Arano Resources, Antofagasta Holdings, Aurex, and Teck.

**PERU**

After its commissioning in August, the Yanacocha mine, located near Cajamarca in north-central Peru, has reached commercial production of about 250,000 oz/yr Au. It is expected that the owners, Newmont Mining (40%), Buenaventura (32.3%) and BRGM (24.7%) will increase production. Current production will come from three deposits with reserves of 1.3 million ounces in minable gold reserves. An additional 5.7 million oz in non-reserve mineralization is expected. Although Newmont and its partners control more than a 25,000 hectare area, and 65% of an additional 202,000 ha. along trend from Yanacocha, exploration activity is reaching a fevered pitch. Concessions have been staked by Newcrest, Crown Resources and others.

Minero Peru's privatization of mining assets commenced with the sale of the Cerro Verde in October to Cyprus Minerals. The operating open pit mine, located near Arequipa in southern Peru, contains reserves of 536 Mmt at 0.74% in copper sulfides, with a geological resource of 800 Mmt at 0.68% copper. Following its purchase price of $37 million, Cyprus plans to upgrade the concentrate plant and SX-EW capacity to process the secondary sulfides at an investment of $485 million over five years. Minero Peru is also offering its gold property at San Antonio de Poto near Puno, and the Michiquillay, La Granja and Canarica deposits in northern Peru.

Centromin, a Peruvian state-owned mining company, has packaged its properties for privatization in March, 1994. It is rumored that Cerro Corona, located 50 km north of Yanacocha, may rate as the coup of the season for American Barrick, and that other in-the-know companies Newcrest, Phelps Dodge and Newmont also bid on the gold-copper porphyry, which is speculated could reach 250 - 500 million tons. Only eight drill holes, most shallow, returned tantalizing results of 1 g/t gold and 1% copper over intercepts of +100m. The stockwork is described as "brilliant."

**ARGENTINA**

Musto Explorations is actively seeking a partner for its Bajo de la Alumbreza copper-gold porphyry project (551 Mmt at 0.52% Cu and 0.7% g/t gold) in Catamarca Province, northwest Argentina. At least ten companies have expressed serious interest. Fluor Daniel's feasibility study is now complete and bids will be closed in the new year. YMAD, the quasi-governmental organization which tendered Alumbreza in 1991, plans to privatize its gold-silver-manganese mine and property position adjacent to Alumbreza in early 1994.

Elsewhere in the Parallon Negro district, an influx of major companies is exploring other copper-(gold) porphyry targets. At Bajo el Durazno, Placer Dome is exploring American Resources' property with an option to acquire up to 70% BHP has signed an agreement with American Resources to jointly explore Mi Vida and nearby concessions held by BHP. Previous drilling (8000 meters) at Mi Vida outlined reserves of between 50 to 60 Mt of 1-2% copper. Near the Chilean border in Salta, Gencor signed an option for 60% of ARC's Taca Taca porphyry copper prospect.

Comsur announced it will tender part of its interest in the El Pachon porphyry copper deposit, located 6 km east of the Chilean border from Minera Anaconda Chile's Los Pelambres copper mine. It has long been speculated that Los Pelambres and El Pachon are parts of the same porphyry system. Minera Anaconda (Lukis Group) is one of several interested companies, but has the added advantage of operating a nearby copper mine. Production from El Pachon would be transported to Chile's coast, 120 km west rather than 1000 km east to Buenos Aires. Reserves defined by Comsur's recent drilling campaign are 57 million Mt at 1.05% Cu and 0.016% molybdenum in the secondary sulfide zone, and 20 Mt at 1.34% Cu and 0.045% molybdenum in Brecha Sur. Overall resources at Pachon total 800 Mt with an average grade of 0.61% Cu and 0.016% molybdenum. The project would benefit from a new agreement between Chile and Argentina which lifts restrictions within the "frontier zone" for project development, sharing infrastructure, power and such.

During October, the province of Chubut, which forms the northern half of Argentinian Patagonia, held a public tender for the first three of twelve mineral reserve areas. The three areas bound the Andean cordillera and all have at least minimal exploration of precious and base metal occurrences.

**ECUADOR**

Gold Fields of South Africa proceeds with exploration of the main gold skarn zone at Nambija, Zamora Province. Although throngs of small miners have removed high grade gold (grades up to 1000 g/oz), estimated at more than one million ounces during the last decade, potential exists for mineralization at depth and elsewhere in the district. The skarn is developed in a structurally-controlled wedge of carbonates and volcanics, stratigraphy bounded on east and west by lobes of the Zamora batholith. Newly-listed junior Zappa Resources is working on properties held by affiliate company Prominex at Ponce Enriques and Guadalupe, previously drilled by Newmont in 1991. The properties, located near the "boom town" of Bella Rica in the coast range, host stockworked copper-gold porphyry and vein targets.

**VENEZUELA**

To date, I have omitted activities in Venezuela for their sheer complexity and often promotional nature. However, recent imprint confirmation of Placer Dome's multi-million ounce gold
discovery at Las Cristinas (4.8 million oz in 124 Mt at 1.32 g/t gold, geological resource) merits notable mention. Placer plans to initiate a feasibility study in 1994. The recent election of a new president hopefully will stabilize the investment climate of Venezuela.

**MEXICO**

*Regional Editor: Robert H. Page (SEG, 1986)*

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Monthly report, annual budgets, and now an SEG Newsletter deadline. This is truly a rotten week. However, duty is something not to take lightly. I will not be cowardly and pretend that I was out of the country and was forced to thereby shirk my duty. Not that there is whole lot of news to report on, which will soon become abundantly clear.

Since September 15 the DIARIO OFICIAL has been publishing a new list every day of 50 claims being voided and the day that they will be open for staking. The process will continue into February, which equates to about 5000 claims coming open. As I understand it, this is unprecedented, and a good sign that SEMIP, the government department which handles claims, is really getting organized. It is also going to provide some opportunities, assuming you can evaluate 50 properties a day. We have only followed up on one claim to date and hope the experience is not typical. When we got to the site to build our concrete monument, the place looked like a construction site. In all, 18 claims got filed on top of the individual claim. Anyone of these 18 who completes the required legal surveys will be put into a lottery. In this case, just the filing fees are $1000 so it is a fairly pricey raffle.

Another government agency, the Fomento Minero, a group of shrewd lenders if ever there was one, is now trying to get some return on their bad loans. This covers, for the most part, all of their loans. Realizing that getting anything back from the borrowers is about as likely as getting snow in Caberco, the Fomento is searching for new investors to develop failed properties. Surprisingly, this may actually work and serve to free up some good properties. The key is that property owners with bad loans will have to sign deals that the Fomento approves. The problem of having to take over the face value of a bad loan and make extraordinary payments to a title holder will disappear. Theoretically, anyway.

Will someone out there please make a stunning discovery? The question arose at a management meeting the other day which asks what is the most exciting exploration property in Mexico. Sad to say, I could not think of a property that really has the industry talking. There are a few false alarms like La Herradura, Bermejal, and Mipillitas. I am not derisifying these properties, in fact I wish I had them, but we need something new that is unquestionably economic.

There actually is some real news on the exploration front. At Metates, deep in the Sierra Madre of western Durango, Cambior has completed a 5000 meter core drilling program with some rumored hot intercepts. However, overall, the average grade appears to be under one g/t within a resource of 200 million metric tonnes. Hopefully, phase 2 will zero in on a part of this resource which is better grade and ultimately economic. Farther north, in the sierras of eastern Sonora, exploration titans Placer and Kennecott may have come to terms for a JV to evaluate and develop the Mulatos deposit.

Lastly, comes news of a 20,000 meter RVC contract for major drilling in southern Mexico. Who has let this? Is it Teck at the Nukay gold skarn? Does someone have that elusive major discovery asked for above? Is this just another ugly rumor to cause me to lose sleep? Watch for the answers next month. Do not expect any, but it will not hurt to check.

**WESTERN CANADA**

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Recently, the Government of Canada published by province, the general exploration plus mine-site exploration expenditures, including field and related overhead expenditures for the period 1991-1993. The expenditures ($ millions) for Western Canada are:

<table>
<thead>
<tr>
<th>Province</th>
<th>1991</th>
<th>1992</th>
<th>1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manitoba</td>
<td>29.7</td>
<td>25.5</td>
<td>22.1</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>31.5</td>
<td>39.7</td>
<td>42.5</td>
</tr>
<tr>
<td>Alberta</td>
<td>6.6</td>
<td>4.2</td>
<td>7.6</td>
</tr>
<tr>
<td>British Columbia</td>
<td>135.7</td>
<td>70.5</td>
<td>57.9</td>
</tr>
<tr>
<td>Northwest Territories</td>
<td>31.6</td>
<td>34.7</td>
<td>32.4</td>
</tr>
<tr>
<td>Yukon</td>
<td>16.5</td>
<td>9.7</td>
<td>8.4</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>251.6</td>
<td>184.3</td>
<td>170.8</td>
</tr>
</tbody>
</table>

The 1993 forecast figures are the result of a survey carried out December, 1992 through March, 1993, and reflect the increased diamond exploration in Saskatchewan, Alberta and Northwest Territories. They do not reflect the $10.5 million being spent by Pacific Sentinel Gold Corp. in the Yukon on the Casoro porphyry Cu-Au-Mo property. The
continuing and dramatic decline in exploration expenditures in British Columbia are largely a reflection of current provincial government land-use policy, an example of which is the creation of the Tatshenshini Park that resulted in the expropriation (from 27 claim holders) of the Windy Craggy and other projects.

Exploration in Western Canada during 1993 has been dominated by diamonds, certainly a girl’s and a junior mining company's best friend, except in British Columbia and the Yukon. There, exploration has been largely focused on late stage projects, particularly porphyry-copper deposits, many of which contain significant amounts of gold and some molybdenum. Manitoba, with its more enlightened mineral policy, is basically holding its own with typical Shield base metal and precious metal exploration, plus minor diamond exploration in the Paleozoic sedimentary rocks near the Saskatchewan border.

**BRITISH COLUMBIA**

Exploration in 1993 in British Columbia includes late stage porphyry-copper-gold deposits, gold deposits and base metal massive sulphide deposits with significant precious metal credits. Considerable progress has been made at the Red Mountain gold deposit, located ten miles east of Stewart near the coast of central British Columbia, where Lac Minerals reports the 1993 program has already indicated a potential for greater than 2 million ounces of gold. The geological reserve in 1992 was 2.8 million tons grading 0.37 ounce per ton gold in the Marc and AV Zones. New mineralized zones identified by surface drilling are the JW Zone, below the AV Zone and the 141 Zone southwest of the Marc Zone. The 1993 program will consist 90,000 feet of surface drilling and 2,800 feet of underground development with 20,000 feet of underground drilling on the Marc Zone, for a total of about $7 million.

The mineralization at Red Mountain occurs near the contact of a feldspar hornblende diorite porphyry (Goldslide intrusion) and Early Jurassic, bedded, intermediate to felsic volcanic clastic tuffs and sediments. The diorite porphyry has been dated at about 200 million years.

Mineralization consists largely of densely disseminated and massive pyrite as stringers and veins, pyrrhotite and sphalerite (in zones) with lessor chalcopyrite, galena, arsenopyrite, stibnite, many varieties of tellurides and minor native gold. The gold is largely present in pyrite and tellurides. Strong to moderate sericitization, chloritization and silification are characteristic of the mineralized zones which define a northwest trend and plunge.

**ALBERTA**

For the first time since the Saskatchewan uranium rush moved westward some twenty-five years ago, Alberta has become part of a staking rush—the Western Canada Diamond Rush. Although some ground was leased for diamond exploration as early as 1990, the rush really took place during 1992 and 1993, when about 70 million hectares were acquired. Preliminary exploration is now being directed towards locating blind drill targets. Earlier, two alluvial diamond discoveries were made, one near Edmonton and the other in the Badlands area of south-central Alberta. In 1993, alluvial diamonds were reported from the Milk River area. Recent work by the Geological Survey of Canada indicates that the southeast corner of the province has the greatest potential for kimberlite discoveries.

**SASKATCHEWAN**

Much of the new exploration in Saskatchewan is diamond related and largely confined to the Paleozoic sedimentary rocks flanking the Precambrian Shield. Exploration is currently being carried out in southwest and south-central Saskatchewan. At least 70 kimberlites are reported to have been located in the Fort à la Corne area east of Prince Albert. The kimberlites are described as relatively flat lying (pancake like) diatremes intruded into Ashville Formation shale of Early Cretaceous Age. Fossil evidence and rubidium/strinum age data on phlogopites gave an age date of about 95 million years. Many of the kimberlites sampled to date are reported to contain diamonds. Sampling completed on 17 kimberlite bodies by Uranex and partners in 1992 recovered 138 macro-diamonds (7.610 carats) with the largest reported stone at 0.985 carats.

**YUKON**

Exploration expenditures in the Yukon have increased dramatically in 1993 largely because of the $10.5 million program being carried out by Pacific Sentinel Gold Corp. on the Casino copper-gold-molybdenum project located in southwestern Yukon. Six drills are systematically testing the 5,000 x 3,600 foot deposit. The Casino deposit is reported to be hosted by a swarm
of Cretaceous subvolcanic intrusions and related breccias—the Casino Intrusions intruded into a foliated Triassic granodiorite—the Klotassin Batholith. Potassic and phyllic alteration zones are present. Primary mineralization consists largely of pyrite, chalcopyrite and molybdenite concentrated in the phyllic zone adjacent to a pyrite halo surrounded by weak argillic and pyropillic alteration. As the deposit has not been glaciated it contains a well developed leached capping underlain by a supergene zone containing typical supergene copper minerals. The latest published (November, 1993) average results of mineralized drill holes within the current deposit area give the following:

<table>
<thead>
<tr>
<th>ZONE</th>
<th>ORE (MILLION TONS)</th>
<th>Cu (PERCENT)</th>
<th>Mo (PERCENT)</th>
<th>Au (GAINS/TON)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leached</td>
<td>31</td>
<td>0.11</td>
<td>0.024</td>
<td>0.020</td>
</tr>
<tr>
<td>Supergene</td>
<td>95</td>
<td>0.43</td>
<td>0.031</td>
<td>0.012</td>
</tr>
<tr>
<td>Hypogene</td>
<td>489</td>
<td>0.23</td>
<td>0.02</td>
<td>0.008</td>
</tr>
</tbody>
</table>

NORTHWEST TERRITORIES

Exploration for diamonds in the NWT continued the rapid pace initiated by the Point Lake discovery in the Lac du Gras Area in 1991. BHP Minerals Canada and Dia Met Minerals have continued to be successful in locating additional diamond-bearing pipes, with at least six more pipes defined by drilling in 1993. A 5,000 tonne bulk sample is planned for this winter from one or perhaps two pipes. Recently, the companies reported results of age dating by rubidium/strontium on mica separates and whole rock samples—52 ± 1.2 million years. Pestic evidence (dinoflagellates, pollen, spores and teleost fish remains) on mudstones incorporated in two kimberlite pipes suggest an Early Cretaceous (Albian) to Early Tertiary (Paleocene) age—97 to 56 million years.

In an area some believe to be part of the northwest-trending "diamond field," BHP/Dia Met, Kennecott Canada and its joint venture partner DHIK Resources drill tested a number of pipes in 1993. The DO27 diamond-bearing kimberlite pipe will be bulk sampled this winter. Age dating is in progress. In the same general area, Kennecott Canada and joint venture partners Aber Resources, Southern Era Resources and Commonwealth Gold continue to discover kimberlites in the Diavik project, where seven kimberlites, three with small quantities of micro-diamonds were discovered in 1992. A significant new diamond discovery (Toricke Pipe) was recently announced by Alberta based joint venture partners, Tanquary Resources, Fibre Klads Industries and Mill City Gold. A total of 152 micro-diamonds and 39 macro-diamonds were recovered from 161.6 kilos of core. The pipe is located about 70 km northwest of the Point Lake discovery.

A number of well-known NWT base metal deposits, High Lake, Hackett River, Hood River and Izok Lake, have been reactivated. The government has been asked to review and largely bankroll a network of roads and infrastructure needed to facilitate the mineral development of the barren lands north of Yellowknife.

ALASKA

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Kencott, personal savior of Merrill Palmer, is back at the Haines barite property—just can't get enough of a good thing. What with the rope work in the late 80s, this exercise gives new meaning to the term "hangers-on." If anyone is keeping count, ASA won the contest of most samples submitted to the lab this field season, with Cominco a close second. The prize is a fishing trip with Chemex's steelhead expert, Rick Van is still around, but will be off to Denver soon (please welcome him there), although he'll work out of Coral Cables, Florida, in Asia and Russian Far East. Most seagulls don't spend that much time in the air, and this is probably the end of airline mileage programs as we currently know them.

Dr. Paul Metz from U-Alaska, Fairbanks explained to a luncheon meeting of the Alaska Miners how he managed to valuate the land of the proposed Mental Health Lands Trust to the tune of $1.5 billion. We think that exploration people tend to be optimistic, but such a value implies existence of several Chuquis or Olympic Dams or

HYDROGEOLOGIC PROCESSES: BUILDING AND TESTING ATOMICISTIC- TO BASIN-SCALE MODELS

June 6-9, 1994
Loon Mountain Resort, Lincoln, New Hampshire

CONVENER
Thomas Torgersen, Department of Marine Sciences, University of Connecticut, Groton, phone: 203-445-2441, fax: 203-445-3484, e-mail: TORGERS@UCONNVM.UCONN.EDU

SELECTIVE TOPICS TO BE DISCUSSED
- parameterization of hydrogeologic models from atomic processes
- laboratory tests of atomic level constructs and models
- field, laboratory, and geochemical methods to test microscale processes
- parameterization of hydrogeologic processes in basin-scale models
- field and laboratory-based methods to define and test these models
- geochemical and geophysical methods to define and test processes beyond the scale of field and laboratory testing

ABSTRACT AND TRAVEL SUPPORT DEADLINE
Deadline: March 10, 1994

FOR FURTHER INFORMATION
Please contact the AGU Meetings Dept., Hydrogeologic Processes, 2000 Florida Ave., NW, Washington, DC 20009, phone 202-462-6990, fax 202-328-0566, or e-mail meetinginfo@kosmos.agu.org.
something. The discussion that followed was reminiscent of those attendant to presentations of Wilderness Study Area assessments of the 1980s. Many people are skeptical about how well one can model mineral endowment.

The Alaska Miners Association meeting took place at the beginning of November, with a well-attended short course on skarns conducted by Larry Meinert and Rainer Newberry. Despite the industry’s troubles, about as many people turned out as in prior years. Those in attendance gave high marks to the instructors, the speakers, the vendors and the organizers, but not to the Friday luncheon that provided many with the Nanook two-step.

It seems like every mining and exploration group knows about and wants to have Nome prospector Dave Lajack on the payroll. Any exploration type in such demand for North America assignments should forget about prospecting and go into career counseling. Dave would be a millionaire after a few visits to Denver and Vancouver.

No news from Goodnews as far as the Pez and the platinum project are concerned. Toni Hinderman was pleased the weather cooperated, even though the project got off to a late start. This one and Illinois Creek bring to mind the Energizer rabbit.

Rob Kerrich was in town and talked of global scale aspects of gold geochemistry to a packed house, even though it’s budget time and there’s a lot of uncertainty in the air.

Rich Hughes and Steve Masterman really have a tiger by the tail trying to deal with permitting and PR issues at the Ryan Lode gold property on Ester Dome near Fairbanks. Top marks to each of them for coming to grips with the technical side of the project on a very steep learning curve. Also up Fairbanks way, not only the merger, but other high level changes at AMAX Gold are making everyone wonder about the short term future of the Fort Knox project.

A little personnel churning was going on in the Panhandle. Cliff Davis, ex-top-dog at Greens Creek, was put out to sun at Ridgeway, South Carolina, only to be lured back to Juneau, this time wearing an Echo Bay hat. Cliff will capably manage the AJ project, and his addition gives even more clout to the local EB organization. Tom Albanese, ex-Nerco, comes away from the debriss of that organization as new manager at Greens Creek—such a move must presage impending production. Have the partners finally stopped squabbling? Did you ever notice that some Folks just don’t have a clue? Feliz Navidad!

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GREAT BASIN
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Despite the overall reduced level of exploration in the Great Basin in 1993, the year produced some significant discoveries or discoveries-in-the-making (Gemfield, Ruby Hill, Mountain View, Goldbanks?) and a few not-so-significant ones (Cattleguard?), as well as major reserve additions to a number of deposits (most notably South Pipeline). Persistence was a key factor, since most successes came in gravel-covered areas within highly explored (“overexplored”) districts where previous efforts failed. 1993 was a banner year for underground mining, as exploration development drifts were started at West Generator, New Deep, Carlin and Rain; and plans were finalized for underground operations at Deep Star, Purple Vein, Getchell and Rosebud. The industry survived the dreaded $200 per claim payment to the BLM. Although a bit poorer, the exploration community may be better off for it—the turnover of claims should infuse new enthusiasm and ideas into some tired old properties. What will 1994 bring? Hopefully, more of the same, provided our elected representatives are wise enough not to legislate the industry out of business.

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Exploration Geologist
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EXPLORATION NEWS

Canyon Resources has come out of the closet regarding their long rumored discovery in Nevada, Mountain View, near Squaw Valley Reservoir about 15 miles NW of Gerlach. The discovery is an epithermal deposit within a rhyolite dome complex, similar to the Hog Ranch deposit about 20 miles to the north. Mineralization is localized along a N-trending fault zone. The discovery hole, drilled in 1992, intersected 155 ft grading 0.038 oz Au/st. Later holes have typically hit zones ranging from 155 ft to 210 thick, grading from 0.022 to 0.035 oz Au/st. Some thick higher-grade zones (e.g. 75 ft grading 0.186 oz Au/st) have also been drilled. The deposit, which is gravel covered, was targeted in part by tracing the source of mineralized rhyolite cobbles in fanglomerates. The project is a JV with Independence Mining, who obtained the property from WestGold.

Restoration Minerals (a.k.a. G. Grauberger) has drilled more than 100 holes in the Goldbanks Hills, about 35 miles south of Winnemucca. The drilling, much of it on 25 ft to 50 ft centers, is focused along a 3000-ft N-S zone next to the old mercury workings at Squaw Butte. Some high-grade intercepts with visible gold are rumored to have been drilled. The intensity of drilling suggests they might have something here. But then, a few years ago didn't USMX... nah, that must have been a different Goldbanks Hills. Teck Resources is also active in the district.

Four drills (3 RC, 1 core) were operating through early December at Kenneecott's Gemfield project, drilling out the mineralization on 200-ft centers. Mineralization is reported to be typical of the Goldfield District: widespread, low-grade gold with erratic higher-grade zones in quartz-alunite altered volcanics. Drill holes typically bottom in fresh granodiorite. Although some high-grade zones (ca. 0.50 oz Au/st) have been intersected, the truly high grades for which Goldfield is famous (tens to hundreds of oz/st) remain elusive at the 200-ft delineation drill-out.

Homestake Mining Co finally made an announcement on the Ruby Hill discovery near Eureka, NV (which should make Ed Flood real happy). The company drilled 125 holes in the gravel-covered area north of the Ruby Hill mine and encountered mineralization (> 30’ grading 0.030 oz Au/st) in 50 holes, lying beneath 50-500 ft of gravel. HMC has reported intercepts of up to 120 ft grading 0.51 oz Au/st and 435 ft grading 0.147 oz Au/st. The true widths of the intercepts were not reported; but it would be hard to drill down a narrow vein for that far! Rigs were recently observed drilling 25-ft offsets. Could this be telling us something about the geometry and continuity of those high-grade intercepts? Homestake plans a $4 million delineation program for 1994, which should keep more than a few drill rigs and contract geologists busy. The company recently staked all open ground between Ruby Hill and the southern end of the Roberts Mountains (a distance of 20 miles). Placer Dome has been drilling on their claims adjacent to the HMC ground.

Amax Gold has been drilling a close-spaced grid at the old Tenabo town site on the Robertson property. The drilling is following up a previous intercept rumored to be hundreds of feet grading about 0.04 oz Au/st in an altered intrusive.
On the Carlin Trend, American Barrick has been drilling 3 significant extensions to ore bodies: South Meikle, North Betze and Screamer/West Betze. These extensions should at least replace the 1993 targeted production of 1.5 M oz Au. Look for an updated reserve announcement in the first quarter.

Has Cattleguard finally been located? The Mining Business Digest (9/93) pinpointed the location, "10,000 feet north of Gold Quarry," but also noted that it was "near the old Carlin Mill." This location would make Cattleguard a truly enormous deposit, since the two points are separated by nearly 9 miles! Stay tuned for updates on this most elusive discovery.

At the extreme NW end of the Carlin Trend, Cornucopia Resources reported a drill intercept of 525 ft grading 0.012 oz Au/ft (1,330 ft - 1,855 ft) in the Hatter area of the Ivanhoe property (about 1 mile NE of the Tollister pit). The mineralization is hosted in upper-plate Valmy Fm. mudstones and silstones. JV-partner Newmont Exploration completed a major geologic mapping, sampling and geophysics surveying program covering the 125-square-mile property, and drilled 11 core and 23 RC holes in 1993.

Independence Mining had 20 drill rigs operating in the Independence Mountains in early December, the most ever at that time of year. The activity is apparently due to exploration success more than to good weather conditions. Independence should more than replace reserves mined this year.

Alta Gold has acquired the Kinsley property from Cominco/USMX, and is reviewing permit requirements to put the deposit (145,700 oz gold at 0.047 oz/st) into production. Alta has also acquired the Grinnell property, a former Billiton prospect, about 15 miles east of the company's Easy Junior mine. Grinnell contains about 60,000 oz gold at a grade of 0.034 oz/st, hosted in decalcified/sanded calcareous siltstone of the upper Joanna Limestone. The deposit is about 100 feet thick and crops out, producing a low strip ratio (about 1:1). Alta will primarily be performing metallurgical studies during the option period.

Uranex drilled the Slaven Canyon property and returned the core of the property to Alta Gold. More drilling is scheduled for 1994 on the Equinox portion of the property, where shallow drill holes targeted on soil anomalies encountered up to 25 ft grading 0.047 oz Au/ft.

Your reporter stands corrected on the Hayden Hill story. Vertical RC drilling was not the problem (as was alluded to last issue). RC—yes, but most holes were angled. The real culprits were a total lack of core drilling (in nearly unconsolidated "rubble" ore zones), a lack of geologic input into the reserve model (not that it wasn't offered), smearing of narrow vein intercepts by indicator kriging, and expectations based on experience with the "Duracell" ore body at Sleeper (where mill-grade ore just kept going and going and going...). There are some lessons to be learned here, notably, never trust engineers who claim they have everything under control.

Pegasus Gold transferred 2 more geologists down south, leaving only 1 in Reno to do exploration in the Great Basin. A development team continues to work on the Tallapoosa project.

American Barrick has restructured its corporate management to emphasize South America and China, and even transferred the Chief Mine Geologist from Goldstrike to Peru.

Independence Mining will maintain its exploration office in Reno, staffed by 4 "permanent" geologists under the direction of Russ Allen, U.S. Exploration Manager. Reno will also be a base for some of the company's international work.

**ACQUISITIONS/MERGERS**

Phoenix Financial Holdings, a Canadian holding company, has gained control of Atlas Corp through purchase of $8.4 million worth of stock, debentures and warrants (and untold millions in environmental liabilities). Phoenix is focusing all efforts on the Gold Bar/Gold Pick/Gold Stone/Gold—whatever properties in the Roberts Mountains, and plans to pump $2.5 million into the property. All remaining geologists (sans Denver managers) have been transferred to the project.

Hecla Mining and Equinox Resources have announced their intent to "merge." The deal, which is valued at about $60 million, nets Hecla about 1.1 million oz gold reserves and a large of good exploration properties. Odds are we'll see Ross Beatty resurfacing with a new junior company before long.
Fischer-Watt Gold, a Nevada-based company which used to explore in the Great Basin, is merging with Greenstone Resources. Greenstone is interested in Fischer-Watt's assets in Central America.

GOVERNMENT (BAD) NEWS

The editor has reminded me that it is improper for a publication such as the SEG Newsletter to show disrespect for our political leaders by referring to them by nicknames such as 'Bubba' and 'Dominityrix,' 'Bozo,' 'Bimbo,' and other similar nicknames are also considered unacceptable. Therefore, from this point on, our fearless leaders will be referred only by their official titles (e.g. "Mr. President" and "Ms. President").

It's old news now, but just in case you live in a cave and didn't hear—the House passed the "Lehman substitute" to the Rahall bill on Nov. 18 by a 3:1 vote. The marked-up version is even worse than the original Rahall bill! The effect is already being felt in the Great Basin, where some companies are restricting activities to private land. We can only trust that our leaders will have the common sense to hammer out a more reasonable bill when the conference committee meets in early '94.

Newspapers in Nevada, and throughout the west, have been carrying misleading anti-mining articles and editorials written by rabid Sierra Clubbers who are either ignorant of the mining industry or downright liars (the worst being a series of articles in the Denver Post—call if you want a copy). Few rebuttals have made it past the editors. It appears that the press is trying to grease the wheels of the upcoming conference committee debate in favor of the environmentalists.

About 50% of the claims in Nevada were dropped on September 1, when the $200/claim rental fee to the BLM came due. Just how many claims were relocated or overstaked is difficult to assess, because most claims had not been filed by the time of this writing. There certainly was a lot of staking going on... just ask anyone who tried to get a contract crew in September or October.

SOUTHWEST

Regional Editor: Michael S. Fulp (SEG 1986)
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I has been a tradition of this quarterly rambling to commence with a diatribe of geo-libertarian politics, but by now you know my views, so let's dispense with that nonsense and get down to important business right away. The Capitol Bar in Socorro was gutted by an electrical fire on 4th of July and is still shut down. Bo (as in Putnam) and Vigilante Band made other arrangements on 49ers' weekend, but the only watering hole for Tecktroids, Lobos, Aggies, locals and dumb field geologists between Abq and TorC is gone. The rumor mill says maybe a refurbishing, complete with functioning men's room plumbing (!), is in the works. We can only hope so, as this column is necessarily short because of a lack of news from the long bar at the Cap.

On the exploration front in New Mexico, Placer Dome completed coring at Great Western, including a deep one of 1,300 feet, with reported disappointing results. They've also picked up the San Simon ground on the Arizona border after a 1,500 foot hole by others in the spring was maybe not deep enough. Drilling is completed at Hachita by the Champ-Challenger JV. What will happen next with the high holding costs a factor? Echo Bay turned back Victorio Peak, but has been seeing some activity in the Nogal-Bonito district. The new VP-Exploration certainly has a fine budget to tinker with Placing at Ancho Canyon and is ready for the big time re: a recent prospectus. Meanwhile, several are chasing a way-exotic copper show on private land on the edge of porphyry country. Bad news for State Trust Land hopefuls, as Baca's politically-appointed successor is a former wildlife biologist-public relations-son of a Democratic Party head and so the mineral lease moratorium continues. ¡Que lástima!

In ski country to the north, Challenger's drilling on the Baca Grant sand dunes hit oil shows in the Precambrian! Could this be better than a gold intercept? Royalstar got Dia Met to share the risk at Skoan so every other subeconomic pipe in the State Line district now has a VSE-listed lessor. Kind of a "trendology" type phenomena, as explained by Bob Cuffney in the last issue. BHP is reportedly active in North Park Precambrian rocks again.
In Arizona, biggest and baddest news hit the street in September as Magma declined at Sanchez. Is the $450K advance non-refundable? Will it cover legal fees on either side? Southern Copper is mining and milling at Oracle Ridge again after the expansion detailed in the fall issue. Buena suerte, stockholders.

BHP can see the fight at the end of the tunnel on the San Carlos Res, as the deal responsible for establishing a Tucson office over a year ago is finally imminent, despite BIA interference and meddling. Why can’t our government let the Indians go free?

BHP is rumored to be pediment drilling southwest of the Glove Mine on the west flank of the Santa Ritas. They’ve also picked up ASARCO’s old porphyry play south of Tombstone with partner Exallion. ACNC has completed another round of drilling at the Kay Mine in the Black Canyon Belt, and ground to the north has been leased to Placer Dome(?). Cambior recently drilled copper targets in the Tortoliitas.

Despite the above-mentioned activity, overall business is slow, although most consultants are as busy as they want to be, especially those of us that can speak the lingo to the south. Many companies, especially the majors, seem to be waiting arrival of the new mining law before making moves these days. As a result, many good exploration properties sit for lack of a deal and $s to drill. Finally, did you know that the nickname of a certain Western Canada NHL hockey team is considered derogatory by gringo editors so that we must refer to them as “Far Northers” in print? Will I ever get this “politically correct” gig figured out?

Just treadin' deep-enough water for another 38 months.

MIDCONTINENT

Regional Editor: Leon E. Esparza (SEG 1977)
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MICHIGAN

Marquette County: The Cleveland Cliffs Iron Co. is considering an expenditure of up to $75 million per year for a reduced iron production facility at its Republic Mine. The iron ore mine and pellet plant has been idle since last summer. The reduced iron product would serve the electric arc furnace segment of the steel industry. Steel makers using other methods, blast and oxygen furnace, have also shown an interest. The plant would produce 450,000 tons per year. Reduced iron products have an iron content of 90%, compared to 65% iron for most pellets. Increased level of purity for the feed material would result in lower steel production costs.

Ontonagon County: Metall Mining Corp. began a feasibility study to expand smelter capacity at its Copper Range facilities to 148,800 short tons per year from 82,800 stpy. Concentrate production would also be increased to accommodate the expanded smelter. Also being studied is the possibility of in situ leaching of underground pillars and recovering copper through solvent extraction/electrowinning methods (SX/EW). Testing of the leaching technology is in progress. Both the feasibility study and testing are expected to be completed by June 1994.

MINNESOTA

St. Louis County: National Steel Pellet Co. idled its iron ore mining and pellet plant in October. Members of the United Steelworkers of America had been on strike at the facility since August, 1993. The facility is a wholly owned subsidiary of National Steel Corporation. The shutdown means lost jobs for 710 people.

SOUTH DAKOTA

Lawrence County: The Golden Reward Mine gold production through the first three quarters of 1993 was nearly 25,000 troy ounces. Cash production costs were $320 per ounce. Production costs improved compared to $339 and $511 reported in the second and first quarters of 1993, respectively. Targeted production for the year remains at 40,000 ounces, at a cash production cost of $330 per ounce. In early October, the Golden Reward Partnership purchased the mining contractor’s equipment and life-of-mine contract for $2.7 million. The Partnership anticipates an annual cash operating cost savings of $1.0 million.
Goldstone Mining initiated legal action against Homestake Mining Co. and its wholly owned subsidiary Whitewood Development. Goldstone has been in partnership with Homestake to develop tailings deposited along Whitewood Creek. Homestake, as the operating partner, decided not to proceed, despite objections from Goldstone. Goldstone's legal challenge claims there is a breach of contract.

Homestake Mining Company gold production at Lead was 111,600 troy ounces for the third quarter 1993. This was an increase of 9 percent compared to the same period last year. Cash operating costs decreased 14% to $267 per ounce. The improved operating costs resulted from continued emphasis on cost cutting programs and stringent grade control.

The Wharf Mine gold production through September 1993 was 74,254 troy ounces. Cash production costs were $179 per ounce; down from $181 last year. Expected production for the year is 100,000 troy ounces at a cash production cost of $180 per ounce. Wharf Resources submitted its Engineering Evaluation/Cost Analysis for the Annie Creek tailings to the Environmental Protection Agency in September. The EPA concluded there was no significant risk of harm resulting from the Annie Creek tailings, either to human health or to the environment. Wharf awaits the outcome of a final EPA decision which will result from consideration of public comments. The comment period ended November 11, 1993.

WISCONSIN

Forest County: Crandon Mining Co.; an equal partnership between Exxon Coal and Minerals Co. and Rio Algom Ltd., has announced it will seek permits to develop the Crandon zinc-copper deposit. The company is proposing a 5,500 ton per day underground mine. The deposit has reported recoverable ore reserves of 30 million tons averaging 9.4% zinc and 0.4% copper. These reserves would carry a mine life of about 15 years. Additional, mostly copper-bearing, material could add about 25 million tons to the reserves, depending on metal markets. The added reserves would increase mine life another 10 years. The deposit was discovered by an airborne electromagnetic survey in 1974.

NEW ENGLAND
Regional Editor Fred Beck (SEG 1959)
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The fall season in New England saw no change from the generally low level of exploration activity (BHP excepted) experienced during the summer. Rumors have it, however, that there may be an increase in activity next year. Aur Resources is looking forward to an active 1994 season on its Boise Cascade and other properties, and there is the possibility that Scintilore (TSE), with a new infusion of capital, may reactivate its exploration in the Big Hill and Barrett properties in eastern Maine. Cominco American has acquired all of the New England exploration data from Cyprus Minerals which had been generated by Superior, Chevron, and Getty during the late 1970s and 1980s. This data-base will provide a good running start and compliment Cominco’s continuing program in New England. BHP Minerals has continued its strong New England and Maritime exploration program, and plans drilling on several prospects this winter.

There is nothing new to report on the efforts to farm out the three potentially commercial massive sulfide deposits in Maine. The Mount Chase deposit (Horizon Gold) was visited by one major group, while Bald Mountain (Boliden) and Alder Pond (BHP) deposits continue to be reviewed by interested parties.
Mineral Resources of Russia
An International Symposium and Exhibition

Visions of wolves nipping at the heels of horses pulling a sleigh across the frozen tundra (à la Pasternak images) were rapidly displaced as our DC 10 sat down at the St. Petersburg international airport. For five days, November 9-13, approximately 400 Russians and 100 foreigners were treated to an “immersion course” on the mineral resources of Russia (metals, non-metals, oil, gas, coal, colored and ornamental stones, building materials, and gems). The meeting was hosted by the Russian Federation Committee on Geology and Exploitation of Natural Resources (ROSCOMNEDRA), the A.P. Karpinsky All-Russia Geological Research Institute (VSEGEI), the All-Russia Research Institute of Geology and Mineral Resources of the World Ocean (VNII "Okeangeologiya"), and the All-Russia Petroleum Geological Research and Exploitation Institute (VNIGRI).

Multiple, simultaneous sessions were held in separate locations, precluding thorough coverage of the technical talks. The difficulty of that task was compounded by marginal graphics and spotty, simultaneous translations. However, many of the talks (too numerous to discuss here) described properties that will soon be offered for tender, with some details on geology, grade, and tonnage. More than 60 exhibits provided ample opportunity to clarify details missed in the lecture halls and to become familiar with the large array of resource and deposit information (including digital maps and data bases) now available. The new openness with information was refreshing and led to several informative discussions. Helping to disperse that information is a new enterprise, GeoInformark, that publishes two journals: "Mineral Resources of Russia: Economics and Management" (in Russian with some English abstracts) and the English language "Bulletin of Legal and Commercial Information" (the Official Publication of the Committee on Geology and Subsurface Usage of the Russian Federation Ministry of Fuels and Energy). The latter publication carries discussions of the evolving legal system as well as announcements of bidding rounds and auctions.

The emerging laws controlling foreign exploration and mining activities as well as the financial stability of contracts and agreements consumed many of the formal presentations and much of the informal discussion time. There were two excellent and at times bluntly critical commentaries on the current “Law on the Earth’s Interior and procedure of licensing exploration and production.” V.P. Shcherbakov, Vice-Chairman of the Geological Committee of Russia, acknowledged that two problem areas involve guarantees and taxes. Both topics are under review and will be addressed by the new Parliament. Of the more than 3000 joint ventures in Russia; approximately 65% are in the service area, 30% in oil and gas and the remainder in other minerals. This mix is close to what is viewed as a reasonable ratio of activities for continued short term development. J. Hill, a consultant, followed with an extension of his recent article (Minerals Industry International, Sept., 1993, p. 3-21) in which he critically evaluated the proposed mining laws.

We received some unfortunate, but not unexpected, information about difficult situations of many of the Russian institutes and individual scientists. Many geologists have been working for 40% of their salaries and several institutes are facing closure. Since returning to Denver, I’ve learned that, due to financial problems, VSEGEI (Russia’s original geological survey) has closed its doors for the month of December. Now, as the winter shadows lengthen in the Colorado Rockies and drowsiness takes control of the mind’s eye, the images aren’t of wolves nipping at the horse’s heels but of the wolves knocking at the geologist’s door.

— R. I. Grauch

SEG/NWMA Session
At the 1993 Annual Northwest Mining Association Meeting

The 99th annual convention of the Northwest Mining Association, held November 30-December 3, had the theme “International Mining.” As part of this theme, two sessions were held highlighting the similarities in geologic terrains and mineral deposits of Russia Far East, Alaska and the Canadian Cordillera. The morning USGS/NWMA session, titled “Metallogenesis and Tectonics of Russia Far East, Alaska and Canadian Cordillera,” emphasized regional concepts. The SEG/NWMA session, titled “Mineral district and deposit studies—Russia and Alaska,” highlighted individual districts and deposits. The audience ranged from 80 to 250 people.

Dr. Vladimir L. Shapkerman, Northeast Interdisciplinary Research Institute, Magadan, Russia, began the SEG/NWMA session with a discussion of Striatiform sulfide deposits of Northeast Russia, his first presentation in English. Thomas K. Bundtzen, Alaska Division of Geological and Geophysical Surveys, described a variety of deposits in Late Cretaceous and Early Tertiary igneous-related metallogenic belts that extend from the Russian Far East into and through Alaska. His co-authors were Nikolai A. Goryachev, Northeast Interdisciplinary Research Institute, Marti L. Miller, USGS, and Warren Nokleberg, USGS. Gregory M. Levitan, JK Minerals, Ltd., with co-author Edward I. Bloomstein, described several gold deposits that occur in the Ural Mountains. Vladimir Berger, USGS (who formerly lived in Russia), described gold-antimony deposits of Verkhoyansk-Kolyma Province, Northeastern Russia. The session closed with an excellent presentation on the enormous Udokan sedimentary copper deposit, Chita Province, Russia by Hal Backer, consultant; Parker, Colorado and co-authors V. S. Checheotkin, Chita Region Geological Committee and Paul Morgan, Goldbelt Resources, Ltd.

— Ron Worl
U.S. Geological Survey
Branch of Western Mineral Resources
West 904 Riverside Avenue, Room 202
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At the SEG luncheon of the GSA meeting in Boston, SEG President Sam Adams presents the Lindgren award to Naomi Oreskes, Dartmouth College (left photo) and a citation to Doug Haynes, distinguished lecturer from Western Mining Corporation, Australia (right).
GEOCHEMISTRY OF ORE DEPOSITS

The seventh Gordon Conference on Geochemistry of Ore Deposits was held at Tilton School, New Hampshire, during the week of August 16-20, 1993, with great success. The 135 attendees, the maximum that could be accommodated, included 20 from industry. Thirty-two conferences from outside the U.S. represented Australia, Canada, Chile, the United Kingdom, Germany, Austria, Japan, Russia and South Africa.

The program was divided into two main parts, with morning sessions on the nature of ore-forming systems and evening sessions on deposit geology and models. The Monday morning session on analysis of metals and gases in individual fluid inclusions included talks about PXE and synchrotron XRF, laser-ICP-MS and quadrupole methods. On Tuesday, a set of talks on adsorption processes and numerical modelling in hydrothermal systems, and on Wednesday, there were talks on fluids in seafloor systems, solubility experiments and PGE's in layered igneous complexes. Thursday and Friday morning sessions focussed on isotopic studies, with talks on dating ancient crustal fluid flow, the use of radiogenic tracers in hydrothermal systems, stable isotope geothermometry and speedometry, and experimental calibration of the hydrogen isotope system.

Evening sessions began on Monday with talks on the epithermal-porphyry transition and went on to talks about sediment-hosted micron gold systems on Tuesday. The Wednesday evening session featured a debate on the role of placer vs. hydrothermal processes in the Witwatersrand followed by an update on Australian Proterozoic lead-zinc sedex deposits. Thursday's evening session focused on basin fluid evolution and MVT deposits. The final session on Friday morning was a roundtable discussion on future challenges for ore deposits research, during which many challenges and ideas were put forth by industry, government and academic participants.

As with all Gordon Conferences, afternoons were left open for discussion, spontaneous meetings, poster sessions and games of all types. Several athletic stars attracted attention, including Steve Reynolds in basketball, Jean Cline in volleyball and Hiroshi Ohmoto (who managed to shoot his age) in golf! Tuesday afternoon, Bob Tracy of VPI led a field trip to several classic metamorphic localities. The meeting was organized by Bob Bodnar, Steve Kesler and Dick Beane, who turned the reins over to the new organizing committee consisting of Mark Reed, Kevin Shelton and Bob Schafer. Keep a space on your calendar for the next meeting, which will happen in summer, 1997.

— Steve Kesler, University of Michigan

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Oregon Student Chapter of SEG

The Oregon Student Chapter of SEG consists of graduate students who are conducting ore deposit and related research under the direction of John Dillies and Cyrus Field at Oregon State University and Mark Reed at the University of Oregon. During the 1992-1993 academic year 17 students were actively involved. The group has been active in two areas: bi-monthly meetings, alternating between the two campuses, in which the students, faculty, or guests give informal presentations of ongoing research; and field trips preceded by student presentations on the deposits. During the past two years, field trips consisted of: northern Great Basin gold deposits (4 days); mineralization in eastern Washington, western Montana and southern British Columbia (days); and massive sulfide deposits in the northern Klamath Mountains, Oregon (2 days). This academic year, a trip is being planned to deposits in California.

—J. Margolis
Dept. of Geological Sciences, Univ. of Oregon

University of Western Ontario
SEG Student Chapter News and Summary of 1992-1993

The UWO SEG Student Chapter (London, Ontario) is pleased to report another year of increased membership, activity and enthusiasm. Jon North (President), Mike Gunning (Vice President), Mike Clegg (Secretary), and Hamid Mumin (Treasurer) and 15 members, with Patricia Sheahan, Konsult International, as External Advisor, and Dr. Bob Holder as Faculty Advisor, enjoyed several illuminating lectures throughout the year, a well-attended spring short course on kimberlites and diamond exploration, and an interesting spring field trip to Michigan’s Upper Peninsula. In addition, countless other activities started in the Grad Pub, all of which were legal (as far as I can remember).

In the fall term Dr. Katsumi Marumo, Geological Survey of Japan, lectured about Comparison of Hydrothermal Alteration Halos of Present and Fossil Kuroko-Type Deposit in Japan; Dr. Bill Pearson, Pearson, Hoffman & Associates Ltd., discussed Professional Registration for Geologists in Ontario; Dr. Bob Brodzowski, Western Mining Corporation, Marquette, Michigan, described Iron Formation Hosted Gold Deposits of Australia; and Dr. Bob Weise, Mt. Union College, Ohio, gave a fantastic travelogue titled “Iceland: Living on the Edge.”

Winter term, Dr. Dave Watkinson, Carleton University, Ottawa, Ontario, presented results about Platinum Group Element Concentration and the Role of Fluids; Dr. Ian Sampson, University of Windsor, Ottawa, Ontario, talked about Raman Spectroscopy; and Dr. Nick Susak, Mineralogical Association of Canada Distinguished Lecturer, University of New Brunswick, lectured on Spectroscopic Studies in Speciation in Hydrothermal Solutions.

Kimberlites and Diamond Exploration was the subject of a one-day spring short course. Six presentations were made to an audience of 95 people by an international group of experts in diamond exploration and marketing including: Martin Rapaport, Publisher of the Rapaport Diamond Report, on Diamond Marketing; Keith Barron, a UWO geology Ph.D. student, on Aspects of Diamond Exploration in Northeast Ontario; Dr. Roger Mitchell, Lakehead University, Thunder Bay, Ontario, on Petrology of Kimberlites; Laurie Reed, geophysical consultant, on Geophysical Methods of Diamond Exploration; Dr. Nikolai Sobolev, Director of the Institute of Mineralogy and Petrology of the Siberian Branch of the Russian Academy of Sciences, Novosibirsk, on the Chemistry of Kimberlite Indicator Minerals; Dr. Chris Jennings, President of Southern Era Resources Limited, Toronto, Ontario, on Diamond Update, Northwest Territories.

Seed money (US$600) for our short course was generously provided by the Society of Economic Geologists to cover air fares, etc., for the speakers at the short course. The short course was a technical and financial success, and the money was returned with thanks. This is a great incentive system, and much appreciated.

Our spring field trip to Michigan’s Upper Peninsula was led by the inimitable Dr. Bob Hodder (Canada’s Honorary High Commissioner to the Yoopee). The trip included a pit tour of Cleveland Cliff’s taconite operation at the Tilden Mine (thanks to Mr. Tom Waggner and staff), a tour of the Archean and Proterozoic geology in the Marquette area, an underground tour at White Pine (thanks to Dick Andrews and staff), and a tour of Keweenawan geology. Three presentations were made by our group at the AIME spring meeting in Houghton.

On behalf of last year’s executive I would like to wish the 1993-94 executives all the best. For information about our chapter correspond by fax (519) 661-3292 or phone (519) 661-3187.

—Jon North
President 1992-93 • SEG Student Chapter
University of Western Ontario

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Dear Editor...

Thank you for providing the opportunity to respond to Robert Illichik's letter regarding the Mining Cycle.

The diagram shown in my Figure 1 (SEG Newsletter, July 1993) was oversimplified, and its sole purpose was to emphasize the point that investment in mining only makes economic sense to both company and nation if the economic return (net present value) of the investment is positive at the start of the high-risk exploration phase. Those not in the industry are inclined to think the investment starts with an orebody already discovered.

The cash flows during the productive phase (phase 3 in the diagram) are far more complex than this oversimplified presentation, and include a significant allowance for the cost of environmental management. Environmental management is not, as Mr. Illichik suggests, something a mining company becomes involved with when production ceases. For all reputable companies, environmental management and reclamation are integral parts of the mining operation. As such, the costs are internally financed by revenues generated from production.

In summary, responsible mining companies regard environmental controls, reclamation and rehabilitation as activities that are for the greater part coincident with the revenue generating phase of mining, not a fourth phase afterthought.

— Roy Woodall
Director of Exploration
Western Mining Corp., Ltd.
Unley, South Australia

Upon reading the Exploration Review in the October issue of the SEG Newsletter (No. 15), I was somewhat dismayed to see that we have descended to the same level of name-calling that heretofore largely has been the domain of the anti-mining crowd. I refer to pages 21 and 22 in the Reviews, where President Clinton is referred to as “Bubba” (The Vice President and Interior Secretary were also given epithets.) I am a strong proponent of the mining industry and have worked hard at educating the public about the need for extractive industry. I also am no more a fan of President Clinton’s “bend with the wind” style of government than I was with Mr. Bush’s similar style. As to our Vice President’s “expertise” on the environment, it should be beneath ridicule.

None of this should matter, however. Unless SEG has changed the format of itself or the Newsletter (and no such change was announced in Boston), it still is a publication of a professional society and must retain the appropriate decorum. If I want to see political name-calling in the name of the mining industry, I’ll read “People for the West!” newsletter (which I do). If we are to command any public respect we need to respect some of our public offices, even if we don’t necessarily respect those who hold them. Before I sound any more like a scolding schoolteacher (which I’m not), I’ll end with the admonition that we fight the urge to trade insults with our opponents, and instead channel that energy into constructive public debate and education (as the editorial on page 2 of the same issue discusses).

— Jeff Rubin
Austin, TX 78731

FROM THE EDITORS

I want to thank Jeff Rubin for reminding me and, indirectly, our regional editors of the need to preserve a reasonable amount of decorum when addressing difficult issues, especially those that provoke explosiveness and denigration of the responsible officials. We will endeavor to follow your well taken admonition.

— R. L. Grauch

I agree with Richard Grauch. We try to present all points of view, but, as this is a professional publication, we need not use derogatory names in the process.

— H.L.O. Huyck
A total of 179 Canadian and U.S. universities responded to the Research Committee's academic questionnaire in 1991. The compiled results are available on a 3.5 inch diskette for $5 from Peter Larson, Dept. of Geology, Washington State University, Pullman, WA 99164-2812. Please specify IBM or MAC.

From the Geoscience Education Coordinator

What a difference one word makes. In the July '93 issue of the SEG Newsletter the first sentence of the last paragraph in the column on Education should read: "the second issue...do NOT require even one geology course..." (emphasis added). Comments?

Following my appeal for review and comments on the Working Paper on Fundamental Understandings for Earth and Space Sciences (FUSS), I received input from nine SEG members. I want to thank all those who took the time to send comments on this important subject. Based on those comments, the main concern is: humans and their earth resources needs (both geologic and biologic). Other comments made by more than one person referred to materials for K-4 grades; their scientific and economic importance is not mentioned at all. Nuclear forces are not mentioned either as force acting in the Earth System or as energy. The interdisciplinary and integration aspect of teaching science is another important issue raised.

During the GSA/SEG Annual Meeting in Boston, about 20 people attended a meeting to discuss the NRC National Science Education Standards (NSES) and the Working Paper on FUSS, in particular. Three people directly involved with the NSES Project provided insights. Robert Richly assured (?) us that earth sciences will have the same weight as life and physical sciences. However, to have the "right weight" we should continue to monitor and to send comments. Charles Groat told us how the comments received are being used, and that among deficiencies mentioned are the earth resources group, geohazards and need for integration. Bonnie Brunkhorst also focussed on integration and the importance of the human aspect. Concerns raised during this meeting will be presented to NRC-NSES.

Comments received by NRC will be used to write a First Draft of the actual standards for grades K-12. After review, the First Draft will be released in early 1994. Those who have requested a copy of the FUSS directly from the Critique & Consensus, National Research Council, 2101 Constitution Avenue, N.W., HA 486, Washington, D.C. 20418 will receive a copy of the First Draft. Those who have not, please write or call Angelo Collins (202-334-1369) and request a copy, then send your comments and also send me a copy of your comments. Thank you.

Of interest: "Solid-Earth Sciences and Society" from National Academy Press is available either as Summary or full report: 1-800-624-6242.

--- Jean Jusilard
(916) 978-4735 • FAX: (916) 978-4715

Following the highly successful 1993 Denver Conference, titled "Integrated Methods in Exploration and Discovery," SEG invites interested groups to submit proposals for the next conference. The SEG wishes to sponsor an ongoing series of conferences focusing on exploration practice and exploration-related research. Proposals should be submitted to the SEG Executive Secretary (John Thoms) for receipt prior to April 1, 1994. SEG will select the proposal that best meets its objectives, and will provide mutually agreed upon financial and program coordination support for that proposal.

The next SEG conference should take place in a well-known center of international exploration and/or mining at some time after February, 1996. Timing of the conference should not conflict with other planned meetings catering to international, exploration-oriented delegations. The proposed conference format should include workshops, short courses and field trips attached to a technical program with oral and poster presentations, keynote addresses and forums, and may include special features of significance in exploration practice. Single oral sessions (i.e. not simultaneous) are strongly preferred.

The whole conference, as well as daily programs, should be identified and introduced through carefully chosen exploration-oriented themes. Proposed themes will focus on successful exploration practice and exploration-related research, incorporating the best of established and new methodologies. A preliminary program outline, budget, request for SEG support, and local organizing committee list is required. Co-sponsorship with other scientific/professional societies is encouraged.

For information about the 1993 SEG Conference, see the July, 1993 issue of the SEG Newsletter, or request a copy from John Thoms.

John Thoms, SEG Executive Secretary
5808 S. Rapp St., Suite 209
Littleton, CO 80120 USA
Tel. (303) 797-0332
Fax (303) 797-0417

MUST RECEIVE BY APRIL 1, 94
personal notes & news

- RICHARD D. HAGNI (SEG 1969) was named University of Missouri Curator’s Professor by the University of Missouri System’s Board of Curators. The Professorship is awarded to outstanding scholars with established reputations in their professions. Dr. Hagni is also chair of the Dept. of Geology and Geophysics at the University of Missouri-Rolla.

- DONALD E. RANTA (SEG 1976) has been elected Vice President, Exploration for Echo Bay Mines. He joins Echo Bay from Phelps Dodge Mining Company, where he was Manager of North American Exploration since 1986.

- KENYON E. RICHARD (SEG 1952) died on October 30, 1993, at the age of 78. Richard was former chief geologist of ASARCO, and a world expert on porphyry copper deposits. Along with J. Harold Courtright, he laid the geological groundwork that led to discovery and development of several major Arizona porphyry copper deposits, including Silver Bell and Mission. He was instrumental in the discovery of several Peruvian copper deposits, including Toquepala. He also discovered the Tayson copper deposit in the Philippines.

Richard was a member of many geologic societies, and held leadership positions in several. He published in various journals, including Mining Engineering. He is survived by his wife, Doris Richard, and numerous family members. A formal memorial will appear in a forthcoming issue of Economic Geology.

- HORACE WINCHELL (SEG 1956) died on July 20, 1993, at the age of 78. Dr. Winchell earned his Ph. D. in geology from Harvard in 1941. From 1938 to 1940, he was Asst. Geologist and Petrographer for the Honolulu Board of Water Supply. During World War II, he served as Research Crystallographer at the Hamilton Watch Co., PA. He joined the Yale Faculty in 1945, becoming Professor of Mineralogy and Curator of Minerals at the Peabody Museum, and retired in 1981. Winchell served as Associate Editor for the American Journal of Science for 30 years, and was a member of numerous professional scientific societies.

Dr. Winchell is survived by his wife, Jean Howland Winchell, and numerous family members.

Publications of Interest

By Patricia Sheahan • Konsult International Inc.
Willowdale, Ontario, Canada • tel/fax 416-223-7750


Special Issues of Resource Geology on Mineral Resources—papers from the IGC (29th) held in August 1992 in Japan:

- No. 14: High grade epithermal tin mineralization in Western Australia. £5.00

- No. 15: Metamorphic provinces and their evolution, magmatic and hydrothermal deposits in eastern North America and central Europe. £6.00.

- No. 16: Hydrothermal systems; gold deposits; industrial minerals and exploration technology. £6.00.

- No. 17: Processes and environments for the formation of fero-manganese deposits. £6.00.


NOW AVAILABLE FROM SEG!

- SEG SPECIAL VOLUME #2: GIANT ORE DEPOSITS

EDITED BY WHITING, HODGSON & MASON (1993. 410P.)

This publication contains articles by C.J. Hodgson (introduction); H. Helmesland ("primary" diamond deposits); A.J. Naldrett and P.C. Lightfoot (Norilsk region Ni-Cu-PGE deposits); R.H. Stillitoe (epithermal gold deposits); C.J. Hodgson, D.A. Love and J.V. Hamilton (mesothermal gold deposits); A.H. Clark (porphyry copper deposits); J.D. Keith, E.H. Christiansen and R.B. Carter (porphyry molybdenum deposits); and H.L. Gibson and D.J. Kerr (volcanic-associated massive sulfide deposits).

Order from SEG (address below). US$35.00 member, US$45.00 non-member; add $10 postage outside U.S. and Canada (accept VISA).

- NEW SEG FIELD GUIDEBOOKS:


ORDER FROM: Society of Economic Geologists, 5808 South Rapp Street, Suite 209, Littleton, CO 80120 USA; Tel. 303-797-0332, FAX 303 797-0417.
CANDIDATES FOR SEG FELLOWSHIP:

To All Fellows:

Pursuant to Article V, Section 2, of the Society's Constitution, names of the following two 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 March 15, 1994. If no objections are received by that date, these candidates will be presented to Council for approval.

Address Comments To:
Bruce R. Johnson, Admissions Secretary, SEG
U.S. Geological Survey
W. 904 Riverside Ave. • Spokane, WA 99201-1087
FAX (509) 747-8980

Sangster, Alan L., Geological Survey of Canada, Ottawa, Ontario, Canada; D. F. Sangster, R. V. Kirkham, Marcos Zentilli

THE SOCIETY WELCOMES THE FOLLOWING NEW SEG MEMBERS:

Joseph Barrollino, Newmont Exploration, Tucson, AZ; Richard L. Bedell, Homestake Mining Co., Sparks, NV; Eric R. Braun, Apex Minerals, Inc., Missoula, MT; Kenneth N. G. Bright, Bondar Clegg & Co., Lynden, WA; Kathy J. Dant, Western Mining Corp., Roxby Downs, South Australia; Stephen R. Davey, GENMIN, Johannesburg, South Africa; Benjamin Gruijic, Western Mining Corp., Roxby Downs, South Australia; Lawrence D. Hoy, University of Montreal and Ecole Polytechnique, Beaconsfield, Quebec, Canada; Alex J. Losada-Calderon, University of Western Australia, East Perth, Western Australia; G. Tarcicio Medina Araujo, Servicios Adm. de C.V., Durango, Mexico; Alan J. Morris, Barrick Gold Exploration, Inc., Elko, NV; Benito Noguez-Alcaranta, Peñoles Group, Hermosillo, Sonora, Mexico; Luis E. Novelo, Peñoles Group, Hermosillo, Sonora, Mexico; Martin S. Oczlon, BHP Minerals International, Nussloch, Germany; Alan L. Sangster, Geological Survey of Canada, Ottawa, Ontario, Canada; Nikolai N. Trofimov, Russian Peoples' Friendship University, Moscow, Russia; Maria B. Wojtchewska, S. S. Papadopoulos & Assoc., Bethesda, MD

THE SOCIETY WELCOMES THE FOLLOWING NEW STUDENT SEG MEMBERS:

Laurie D. Benton, University of Tulsa; Stephen B. Boden, University of Tasmania, Australia; Timothy J. Cronan, Castleton State College; Robert L. Guy, Queen's University, Canada; Robert E. Hannigan, University of Rochester; Alexander Iriamno, University of Colorado; Ian D. Kerr, University of Windsor, Canada; Philip C. Larson, Dartmouth College; Richard M. Osborne Jr., Bowling Green State; Mikael Pedersen, University of Copenhagen, Denmark; Thomas Pichler, Colorado School of Mines; Robert C. Thomas, Auburn University.

U.S. Geological Survey
9th V.E. Mc Kelvey Forum on Mineral Resources
February 22-25, 1994
Tucson Convention Center
Tucson, Arizona

Featuring:
- Mineral resource-related environmental studies
- Geology and mineral deposit studies of the southwestern United States and Latin America
- Mineral resource assessments of federal lands and land use planning

Field trips include:
- Silver Bell porphyry copper deposit
- Structural geology and mineral deposits of the Rincon and Santa Rita Mountain terranes
- Laramide porphyry systems at San Manuel and precious metal deposits of Mammoth
- Tucson Mountains caldera
- Historic mining camps of southeastern Arizona

For more information contact:
Warren C. Day
U.S. Geological Survey, Box 25046, Mail Stop 905,
Denver Federal Center, Denver, CO 80225,
(303) 236-5568, fax (303) 236-5603

Co-sponsored by the University of Arizona,
Arizona Geological Survey, and Arizona Geological Society
SOCIETY OF ECONOMIC GEOLOGISTS

1994
Feb. 14-17, with Society for Mining, Metallurgy and Exploration (SME), Albuquerque, New Mexico; see announcement for details, Clay T. Smith, Dept. of Geosciences, New Mexico Institute of Mining and Technology, Campus Station, Socorro, New Mexico 87801, USA. Tel. 505-333-0453, fax 505-835-6493.

1995
March 6-9, with Society for Mining, Metallurgy and Exploration (SME), Denver, Colorado: Robert W. Barket, 6202 Vivian St., Arvada, Colorado, 80004 USA. Tel. 303-422-3186, fax 303-424-5083.

OTHER EVENTS

1994
April 24, Colorado School of Mines SEG Student Chapter and Dept. of Geology and Geological Engineering, "A Perspective on Ore Deposits after 45 Years of Research" Conference, to honor Dr. Richard Huntington's retirement: Dept. of Geology and Geological Engineering, CSM. Tel. 303-273-6300. Proceeds go to SEG Student Chapter.
May 15-10, James Cook Univ., EGRU and Association of Exploration Geochimists, 17th International Geochemical Exploration Symposium, "Exploring the Tropics": Russell Myers, National Key Centre in Economic Geology, Geography Dept., James Cook Univ. of North Queensland, Townsville 4811, Australia. Tel. 61-77-81-5252, fax 61-77-81-5522.
May 10-18, Geological Association of Canada-Mineralogical Association of Canada joint annual meeting: Mr. Alan V. Morgan, Dept. of Earth Sciences, University of Waterloo, Waterloo, Ontario, Canada. Tel. (519) 885-1211 ext. 3209, fax (519) 746-7404 (Associated short courses: "Advances in Flotation Processes Associated with Ore-Forming Systems" and "The Environmental Geocycles of Sulphides: Mine Tailings.")
May 10-21, Pan-American Current Research on Fluid Inclusions (PACROFI) V, Cuenca, Moreno: Dr. G. Molino, Instituto de Investigaciones Geologicas y Geofisicas, Departamento de Geologia, Av. Bolivar 647, Cuenca, Moreno 62000, Mexico. Tel. (73) 18381 ext. 7921, fax (73) 18258.
May 30-June 12, Mineral Deposits Division of Geological Association of Canada Economic Geology field trip to Turkey: Dave Moore, Cominco Resources Intl., Ltd., 400-200 Burrard St., Vancouver, B.C., V6C 3L7. Tel. 604-666-3064, fax 604-662-3166.
Aug. 12-18, International Association of the Genesis of Ore Deposits, 9th IAGOD Symposium, Beijing, China: Dr. Wang Zijia, 9th IAGOD Symposium, Chinese Academy of Geological Sciences, 26 Baiwanzhuang Road, Beijing 100037, China.
Dec. 14-16, Giant Ore Deposits II, Queen's University, Kingston, Ontario, Canada: Dr. C. J. Hodgson or Dr. R. Mason, Dept. of Geological Sciences, Queen's University, Kingston, Ontario K7L 3N6. Tel. 613-545-2597, fax 613-545-6592.

1995
April 3-7, The Geological Society of South Africa Centennial Geocongs: The Congress Secretary, Centennial Congress, P.O. Box 36615, Menlo Park, 0102 South Africa. Tel./fax +27-12-47-2389.