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The Professional GEOLOGIST

FEATURE

Special Report... Mining Geology

Mining Geology

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[Due to the tremendous response to our request for mining geology related articles, AIPG will have two issues featuring Mining Geology. Part 2 will be in the April 1992 issue.]

COVER - Loading explosives in an underground limestone mine. Photograph was submitted by Robert C. Freas, CPG-2673 - article on page 5.

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The Professional Geologist (USPS 590-810 and ISSN 0279-0521) published monthly by the American Institute of Professional Geologists, 7928 Vance Drive, Suite 103, Arvada, Colorado 80003. Second Class postage paid at Arvada, Colorado. Subscriptions for all Members and Affiliates in good standing are included in annual membership dues. Subscription prices are $15.00 a year for Members' additional subscribers and $28.00 a year for non-members for 12 issues (outside the U.S. add $5.00). Single copy price is $1.50 for Members and $2.50 for non-members.

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MINING GEOLOGY

PART 1

Photo Credit: USGS - Twin Buttes Mine, AZ
Mining Geology

Robert C. Freas, CPG-2673

Introduction

Applied geology in the minerals industry or "mining geology" is, on the surface, less glamorous and lower profile than the environmental and engineering geology disciplines wherein a large segment of our AIGC membership earn their living. Yet mining geologists perform a wide array of tasks, some quite basic, some quite sophisticated, and many interfacing with the regulatory environment. Thus, this article is intended to provide an overview of those activities which comprise mining geology and update the reader on emerging technologies.

Exploration

No matter whether the geologist's emphasis is on metals, industrial minerals, or fuels, the exploration for and delineation of mineral deposits is a basic responsibility requiring good old-fashioned geologic diligence. This, combined with proficiency in mineralogy, structural geology, geophysics, and geochemistry, provides the backbone of mining geology. Increasingly, the geologist also needs an understanding of computers and to be proficient in computer applications.

While many mineral deposits are located in areas of abundant geologic data, frequently exploration targets are located in Third World countries with limited geologic mapping and information. In some instances, this lack of geologic information is a result of a deficiency of basic technical resources or governmental emphasis. In others, as in some Eastern Block nations, security concerns have resulted in information being intentionally misrepresented or disguised. In extreme instances, general use road maps may be all that the geologist has available to him.

Exploration targets are usually buried with no apparent surficial expression or are in areas of conflicting land use. Vein ores and precious metals frequently provide the additional challenge of occurring in exceedingly low concentrations and in complex geologic environments. Industrial mineral deposits may have very limited areas of occurrence, have unique chemical requirements to satisfy end use performance needs, and usually require liberal doses of economic geology during exploration. The coal geologist is not without challenges as well, as coal occurrences may be complicated by interbedding, truncation, and extreme topographic conditions.

However, technical innovation is providing the exploration geologist with an increasing array of tools. The computer has been a major factor in these advances; as, for example, geophysical data collected through electromagnetic wave surveys, induced polarization, etc., are fed into a database. Computer aided design (CAD) programs are then employed to test computer simulated sub-surface regions and structures, and to identify drilling targets. Subsequent core drilling may be further supplemented with surface to core-hole and/or core-hole to core-hole resistivity and seismic measurements. These data bases may be further enhanced through XRD/XRF logging or micro mineralogy provided through transmission electron microscopy (TEM).

Geochemistry can also be an important part of the exploration program. Trace metal imprints, soil gas chemistry, and biochemistry may be of particular value to the exploration geologist. For example, highly anomalous concentrations of CO2 and O2 may be found in soil gases.
over massive sulfide deposits, or patterns of metal resistance in soil or aquatic populations may be indicators of ore occurrences. These methods are not restricted to metals but may also be used when exploring for industrial minerals as well. Soil chemistry, soil anomalies, and occasionally botanical indicators may be used in exploring for talc, mica, zeolites, and some clays, or even high purity carbonate deposits.

Geostatistics are an important part of the exploration effort and utilize far more than just the CAD programs. Kriging, which is a geostatistical method of estimating ore reserves and structural boundaries, has been employed by mining geologists for several years. Kriging systems typically rely on Gauss elimination algorithms and can be used in the development of point and block control, particularly in metallic and precious metals deposits. A second geostatistic method finding application with exploration geologists is the "expert system". Computer expert systems, which are rule based, can greatly expedite analysis and enhance decision making. This is particularly important in making the go/no go decision on exploration targets and other mine development and operation questions.

Mining Operations

Applied geology in mining operations is the area where the geologist most frequently interfaces with the mining engineer. Principal areas of geologic involvement include mine planning, rock mechanics, (i.e., roof control in underground mines and slope stability in open pits), dewatering, and quality grade control.

Rock mechanics in underground operations usually involves instrumentation to measure and/or monitor roof and floor convergence, stress measurement, and computer analysis to predict ground conditions and subsidence. The geologic environment and the mine method employed frequently impose intense and complex mechanical forces within the rock mass which are unique to each mine. As an example, subsidence prediction and control within the coal industry has taken on a changing complexity with the advent of longwall mining methods. This involves the mining of a panel several hundred feet wide with controlled roof failure behind the support machinery. This system allows for a higher degree of coal recovery but does present some unique operational and geological challenges.

Rock mass analysis; fracture set orientation and inherent stress resulting from depth; and the structural geology in which the ore occurs must all be taken into consideration in the rock mechanics program. Extensometers may be used to measure convergence and roof sag, particularly in cross-cuts. Pillar loading may also have to be monitored.

An additional area of geologic involvement is in the development of flow net simulation in both underground and surface operations. These efforts may have a significant impact upon mine planning, as the pattern of ground water inflow can impact on mine safety, particularly in the areas of roof control and/or slope stability. The geologist may also have to take a look at the area of influence under maximum drawdown conditions to determine the potential impact on neighboring domestic wells and municipal water supplies. Mine water discharges will also have to be taken into consideration as ground water frequently is in contact with metals inherent in the mineral deposit.

One other area of involvement for the geologist is that of quality control, particularly in industrial minerals operations. Because industrial minerals frequently are "ready to use" and are a component of the customer's product, the specifications may be quite rigorous and require statistical process control (SPC). This in turn may require selective mining or the blending of ore from one part of the mine with ore from other areas. An example of these are the raw materials used in the production of glass, a manufacturing process which has extremely rigorous chemical and physical specifications. SPC is increasingly a driving force in industrial minerals quality control programs, particularly when the mining/mineral processing company is supplying a first or second tier supplier to the automotive industry (i.e., mineral filler for thermoplastics, rubber compounds, etc.).

Environmental/Regulatory

Environmental and regulatory responsibilities are a critical part of the mining geologist's duties, as they are with most other geologic disciplines. Water quality and waste disposal employing the best available demonstrated control technology (BADCT) are critical to the successful mining operation. Water discharges from de-watering operation, waste water generated in mineral processing, and the disposal of waste products in an environmentally acceptable manner are as much a concern to the mining industry as are the disposal of waste produced in other industrial and municipal operations including landfill operations.

Other regulatory concerns of the mining industry include the implementation of wetlands regulations and revisions to the 1872 Mining Law. These are of particular concern as both wetlands definitions and the ability of our industry to continue to develop mineral deposits on public lands will significantly impact where and how mining can be carried on. Thus, the development of mine plans, reclamation plans, closure of abandoned mines, and the selection and design of mine tailing disposal sites will continue to require an increasing level of geologic proficiency and involvement.

Interestingly, environmental regulations have also had an impact on mineral sales and distribution. Requirements for minerals used in environmental cleanup and enhancement have created new markets for lime, limestone, soda ash, zeolites,
clays, and several other mineral products. Market share and distribution can also be affected; as, for example, acid rain legislation is expected to be a motivating factor in coal source switching from high sulfur eastern coals to low sulfur western coals.

Other Areas
A discussion of mining geology would not be complete without some mention of its management and other aspects. One of the lesser known facts, outside of the mining and oil communities, is that frequently the geologist is also the land man. In other words, it is not uncommon for him to be intimately involved in the negotiation of options to lease or purchase mineral properties.

The geologist is also a key player in any due diligence process the mining company may undertake during a potential merger or acquisition. His understanding of economic geology is equally as important as the reserve estimation and is an important aspect of his responsibilities.

Finally, because of the very nature of the companies employing mining geologists, there are generally reasonable opportunities for advancement. However, most of us in mining are there because we enjoy it and it is both challenging and interesting. Traditionally, there has been considerable mobility of geologists between companies within the mining industry, but seldom do those of us who call ourselves mining geologists leave the mining industry. Looking ahead, there are several indications that our industry will be short of qualified new graduates in mining geology. Enrollment in these programs are down, and there is some question as to where our new mining geologists are going to come from.

Robert C. Freas is the Vice President, Marketing for the Franklin Limestone Company, Nashville, Tennessee as well as the Vice President, Finance and member of Board of Directors for the Society for Mining, Metallurgy and Exploration (SME)*

This colorful poster is available by sending a pre-paid order to Mineral Information Institute (MII), 1125 17th Street, Suite 1800, Denver, Colorado 80202. Single copies are $3 each; two or more posters are $2.50 each. The poster's reverse side contains information about rocks, minerals, and mining. Common rock types and their formation are discussed. Mineral elements and groups are listed. Crystal systems and hardness are identified. A variety of nonmetallic rocks and minerals are listed with some of their uses. Exploration, mining, processing and reclamation are highlighted with a brief glossary. This poster was created in cooperation with the National Energy Foundation. Suggestion to AIPG Members: purchase copies as gifts to classroom teachers in your area.
Geology of the Chandler Barite Mine, East Tennessee

Cynthia R. Coron, President, Nikah Resource Consultants and Assistant Professor of Geology, East Tennessee State University

 Deposits of similar age have been documented in the Max Patch Granite near Stackhouse, NC, where a relationship to thrust faulting was suggested by Keith in 1904, but never proven.

The Chandler barite deposit is located southeast of Wilson Knob near Flag Pond, TN, in Unicoi County (Figure 1). In contrast to younger, sediment-hosted deposits like those of the Fall Branch area and the Del Rio mines, the Chandler barite occurs as irregular lenses and veins in the Proterozoic age Cranberry Granite Gneiss, which crops out in an elongated NE-SW belt paralleling the general trend of the Appalachians in eastern Tennessee and western North Carolina.

The deposit was strip- and shaft-mined in the 1920s and again in 1957, when a 30 foot shaft was sunk in a vertical vein, with a 50 foot drift along strike. The exposed vein ranged in width from 1.5 to 4 feet, and today extends approximately 300 feet in the mine vicinity. Mining has since been discontinued, but several shafts (Figure 2), pits, and tailings piles (Figure 3) are visible at the site.

Two additional prospects are known to lie along the strike on the opposite side of the ridge, within approximately 3000 feet. All veins strike N 66° E. Appalachian-age thrust faults have been mapped in the area, but no direct connection with the barite deposits can be demonstrated.

The mineralogy at the Chandler Mine is simple; only barite, pyrite, and quartz. The barite is fine-grained to crystalline, and some ore is vuggy in nature, with quartz and later manganese oxides occupying the vugs. The pyrite and some of the quartz appear to be a co-precipitant of the barite. The lack of occurrence of associated minerals like fluorite, galena, and sphalerite, which are common in other east Tennessee barite deposits (e.g., Sweetwater, Copper Ridge), raises questions concerning the origin of the mineralization at Chandler, particularly when placed in a regional context.

Ore Models

A feature of many barite deposits, as with Mississippi Valley-Type zinc-lead deposits, is the restriction of large volumes of barite to thin stratigraphic intervals. These deposits may result in several ways:

1. Ore control could have been provided by faulting. The structure of the Williams type of deposits at Del Rio is characterized by a series of low-angle overthrusts, four of which are mineralized. Extensions of the Del Rio faults into Great Smoky Mountains Park are known to have been reactivated several times since their postulated initial development in the early Cambrian (Maher, 1970). Re-activated basement faults have been suggested by numerous authors.

Figure 1. Location map showing the Chandler Barite Mine site and the Del Rio and Fall Branch barite districts.

Figure 2. Photograph of the 1957 vertical shaft now water-filled.

Figure 3. Barite tailings at the mine site.

Stable Isotope Geochemistry

Preliminary results of stable isotope analyses of the barites indicate an average delta 34Sulfur value of +26.4. This is significantly heavier than values inferred for Precambrian seawater. These values cluster around +10.0 to +15.0 at the heaviest. However, the Chandler delta values are consistent with those of Cambrian seawater, which may place time constraints on the formation of the deposit. Field studies have established that remnants of the Cambrian shoreline in east Tennessee can be mapped in the immediate Chandler vicinity near Wilson Knob.

A second interpretation of the analyses might involve enrichment in heavy sulfur by the addition of juvenile fluids from depth. The age of barite mineralization could then be closely related to the formation of the Proterozoic host and be considered part of the early rifting of the Atlantic continental margin.
(including Coron for Mississippi Valley-Type zinc deposits in Newfoundland, Haase and Hasson, 1986, for east Tennessee) as conduits for ore fluids.

2. Thin, high grade barite lenses may result from emissions of juvenile waters charged with barium into submarine environments through vents on the seafloor. These beds are consequences of the coincidence in time of barium-emitting submerged vents, sulfate-charged seawater, and the lack of enough sediment to dilute the barite. Cross-cutting veins in older formations in close proximity to bedded deposits could be taken to represent the original passageways of the ore solutions. The Williams veins at Del Rio may represent such ore paths for bedded deposits that were thrust farther westward during the Appalachian Orogeny. Shale-hosted massive sulfides form on the seafloor in a similar manner. Black smokers, like the zinc bodies at Ducktown, TN, differ from barite-dominated white smokers only in their mineralogy. Hot spring mineral deposits on the East Pacific Rise typically consist of basal sulfide mounds surmounted by sulfate-sulfide "chimneys" which, when active, vent fluids at temperatures up to 350°C (Haymon, 1982). Cooler, white smoker chimneys emit milky fluids bearing amorphous silica, barite, and pyrite.

In addition, numerous occurrences of barite nodules in Cambrian and Ordovician shales along the Appalachians from Tennessee to Pennsylvania may represent small-scale exhalations of vented barium (Nuelle and Shelton, 1986) similar to those forming on the seafloor today off the coasts of California and Ceylon.

**Anomalous Element Concentrations**

Figure 4 illustrates the results of a comparison of major and minor element concentrations in east Tennessee barite deposits. Those elements shown are the only elements with anomalous concentrations among the deposits analyzed. All other elements registered equal concentrations from deposit to deposit. The graph shows two like populations: 1) a grouping of Chandler, Lost Creek, and Del Rio and 2) a separate area for Sweetwater and Fall Branch. Implications are that members of groups are genetically related. Sweetwater barites, known to have accumulated in a Mississippi Valley-Type setting (see Zimmermann and Kesler, 1981, among others), show significantly above-background levels of cobalt and nickel, absent in the Chandler deposits. Exceptionally high levels of mercury in the Chandler barites and, to a lesser extent, at Lost Creek, may point to a juvenile component in the fluids. Samples from the Lost Creek deposit, judged to be an exhalite deposit by Kesler and others (1988), show similar trends to the Chandler Mine samples.

**Ore Genesis**

The mineralogy at the Chandler Mine (barite, pyrite, and quartz), the vein-like habit, the possible sulfur isotope enrichment, and the presence of nearby metavolcanics of the same age point to the possibility of a white smoker origin for the deposit. The barite veins probably represent a feeder/conduit system developed proximal to the volcanic center. Bedded barite or barite nodules on the original seafloor fed by the Chandler system may have been thrust westward during orogeny. Deposits at Lost Creek, Del Rio, and Pall Mall in central Tennessee or, possibly, a previously unidentifed deposit may represent the exhalite component fed by the Chandler conduits.

The NE-SW trend of the Chandler area veins may parallel the Precambrian interior rift trend. This interpretation is as valid as assuming that the strike of the veins is the result of later orogenic overthrusting developed along the same trend.

White smokers and bedded barite may have developed along the Late Precambrian - Early Cambrian continental margin. Superheated seawater refluxing through the volcanic pile, becoming progressively enriched in barium, silica and iron, vented onto the Latest Precambrian or Early Cambrian seafloor.

The conduit system, in which seawater and juvenile fluids mixed, was developed in Precambrian basement rocks, but vented onto a younger seafloor. This situation is analogous to that of a spreading center like the Gorda Ridge, which has black smokers venting onto the modern seafloor. White smokers—barite, pyrite, silica exhalations—form in similar locations, and frequently precede, in both time and space, the development of the sulfide chimneys.

Further investigation of the Chandler and other Tennessee barite deposits utilizing sulfur isotope and 87Sr/86Sr ratio analyses need to be undertaken before this genetic model can be substantiated or modified, and deposits such as these can be placed into the context of the metallogenic history of the Appalachians.

**References Cited**

Timmons Speaks Out On Mining Industry

Bobby Timmons, CPG-2736, is no shrinking violet when it comes to educating the public on the importance of the aggregate mining industry. A certified professional geologist who operates his own consulting firm in Jacksonville Beach, Florida, he contends that geologists are primarily "closet scientists" who have been lax in touting the mining industry and long-range zoning for multiple sequential development of mineral sites.

Timmons regularly tries to change the public attitude about mining by presenting papers to national civic and scientific organizations, by authoring published articles on aggregate, and by not being afraid to speak out. "If I had my way," said Timmons, "there would not be so many restrictions frustrating the mining industry. Also, every government regulator and every academician should be made to spend two of every five years of their employment out in the field. Dealing with the bureaucracy is sometimes similar to shaking hands with an immense octopus."

In 1987, Timmons won the Martin Van Couvering Memorial Award for "outstanding contributions" to the American Institute of Professional Geologists. He has worked as an employee for large aggregate-producing companies, the Florida Department of Natural Resources, and the Kentucky Department of Mines and Minerals. He also has worked as a geophysicist. His consulting company has served 39 clients in 32 states.

Early on, Timmons made personal sacrifices to be involved with the aggregate industry. During his senior year in college, he cut all of his Monday classes at the University of Kentucky to map, in detail, the Mississippian Limestones along the eastern belt of outcrop in Kentucky for an Ohio crushed stone producer.

"Even though I am inclined to be opposed to having another level of government," said Timmons, "I would favor mineral zoning if it is based on scientific fact or evidence that there is retrievable mineral rock at specific sites, rather than being based on decisions governed by political whims or votes."

Timmons added that, "California leads the way in long-range mineral zoning. If Florida had matched the strides that California is making, we would not have made mistakes such as we did in Pinellas County (Florida). I worked a naturally bloatable clay deposit there that was ideal for producing lightweight aggregate. It had a wide firing range, and it became pyroplastic at a much lower temperature than existing operations. When you drive south of Tarpon Springs you can see an increase in elevation to almost 100 ft, caused by the underlying clay aquiclude, within a mile of the Gulf Coast. Such elevations near the coast are unbelievable in Florida. That Pinellas clay deposit has been lost forever because of commercial development. If the area had been developed sequentially, it would have increased in value due to the mining operations that occurred there."

Around 95% of Timmons' consultancy work is involved with the aggregate industry. "There aren't many aggregate geologists around," said Timmons. "Most geologists are attracted to the glamorous fields of gas, oil, hydrology, and environmental geology. Geologists coming out of college have had little, or even any desire to have, field experience. They have listened to a lot of classroom lectures, but they lack hands-on experience in the field."

Timmons hopes he has had a part in seeing that the laws and regulations governing the mining industry are made by people that are aware of the total consequences of their actions, and that the decisions they make are based on supportable data. "The big dilemma facing our industry," said Timmons, "is that we have people in policy-making situations who have scant knowledge of the aggregate mining industry."

ROCK Products, A MacLean Hunter Publication, November, 1990-
Slope Stability Analysis for Open-pit Mines

Gregory A. Hahn, CPG 7122

Introduction
Slope stability analysis is the geologic evaluation of the integrity of material destined to be left in the walls of an open pit mine. Historically, slope stability analysis was rarely considered until either a slope failed or a regulatory problem surfaced with the specific design implemented or desired. Closer attention to lowering operating costs by increasing pit slope angles and new regulatory requirements have heightened interest in slope stability analyses, which are being initiated as early as the project feasibility stage and often continue through mine development and operation.

Slope stability analysis is relegated frequently to a design engineer. An engineer's analysis frequently lacks the detailed geologic information which is available when the analysis is done by the project geologist. When an ultimate pit failure occurs, it is usually because insufficient geologic data was gathered during the initial analysis to recognize the potential problem.

What Is Slope Stability Analysis?
Rock slopes in open pits typically fail by one of three failure modes: 1) rotational failures, 2) mass wasting, and 3) structurally controlled failures.
Rotational failures are almost always restricted to homogeneous, weakly consolidated land masses (dumps, shales, clays, or highly weathered rocks such as laterites or saprolites). The probability of rotational failure in competent rock with any inherent strength is considered low enough to preclude serious consideration in most open pit mine scenarios. Mass wasting is generally manageable by good maintenance of slope-faces and catch-benches during mining.

Structurally controlled rock slope failures represent the dominant failure mode in hard-rock open pit mines. These failures result from slippage parallel to one or more rock mass discontinuities which are exposed by open pit mining. There are three major types of structurally controlled slope failures. These are: 1) plane failures, 2) wedge failures, and 3) topping failures (Figure 1). All three failure modes are a result of local planar geologic features (faults, shears, joints, fractures, beds, etc.) which may be present within a given slope orientation in any pit.

The significant physical and mechanical properties of the rock mass are a function of the attitude.

![Figure 1. Graphic representation of structural data from possible slope failure modes, plotted on equal-area nets as poles and great circles (after Hoek and Bray, 1974).](image-url)
geometry, and spatial distribution of these defective planes or discontinuities. Slope stability analysis involves the synthesis of all planar geologic data through stereographic projection. It includes an evaluation of the orientation of the geologic features present in a proposed mine area and the intersection of these features with a set of proposed pit faces.

This method of analysis determines the "potential" for stability for any set of slope design criteria. The analysis is kinematic only; that is, it considers only the motion or potential motion of masses without reference to forces that cause them to move or not to move (i.e. seismic acceleration or cohesive resistance). It also assumes dry ground conditions prevail. Ground water produces hydrostatic pressure, which decreases the stability determined through kinematic analysis.

Conditions which have "potential" for instability require more detailed geotechnical investigations and engineering analysis. Such conditions include, but are not limited to, the presence of ground water above the desired pit bottom, high seismic risk, potential failure modes identified by slope stability analysis, and the presence of incoherent material within the desired pit limits.

Gathering Data
The objective in the initial slope stability analysis is to assess the potential for large slope failures first, small slope failures second, and bench-face failures third, in the order of their potential impact on worker health and safety and operating costs. The collective experience of mine geologists and engineers concludes that large slope failures are caused by large discontinuities and small discontinuities cause small failures. Emphasis during field mapping should be placed on large and intermediate-sized structures. Hairline fractures are unlikely to affect slope stability significantly unless they reflect the influence of a large unexposed discontinuity nearby.

Surface geologic maps rarely contain sufficient structural data for slope stability analysis. It becomes necessary to map structures in detail (1:120 or 1:240) and catalog the orientations of structures exposed in the field. Drill roads on advanced stage projects generally provide excellent exposures for mapping structures. Monitoring of slope stability during operations is readily accomplished by mapping of geologic structures as part of the daily pit mapping routine. The sudden presence of potentially dangerous and previously unknown structures will be identified immediately and thus allow signalling of caution in situations of concern prior to incipient slope failure.

Documentation of the character of the discontinuities is critical in deter-
mining the probability of failure and the internal angle of friction for the discontinuities. The geologist should record features like the spacing of discontinuities, their persistence (along strike or down-dip), roughness, variability in attitude, irregularity in lengths, apertures and any filling material, crystal intergrowths on the surfaces, etc. All of these features serve to bind and strengthen surfaces and tend to improve the stability of a given potential failure mode.

The more structural data that is collected the better the foundation on which the analysis can be built. Statisticians recommend acquiring at least one hundred attitudes per structural domain under evaluation. Some pits might have eight domains (the octants of the compass for a circular pit, for instance). By obtaining as many data points as possible, one insures that a statistical representation of all structures exists. It may take several weeks to map structures in an area that covers a large deposit. This is a small investment for the rewards inherent in the selection of stable pit slope angles.

Data Synthesis And Analysis

The structural data is synthesized using stereographic projections and plotting poles to planes. This method reduces hundreds of planar measurements to a single plot of population statistics, and allows one to focus on the dominant structures within a given domain. Several computer-driven databases and stereographic projection programs are available for easy and efficient handling of data.

The slope stability analysis begins once the field data is plotted and contoured. Figure 2 presents a typical stereographic plot for data from one open pit gold-silver mine in southern California. The proposed pit slope angle and the friction angle for the discontinuities in the mine area (assumed to be 30 degrees) are drawn on the stereographic plot. They represent the window within which any structures that are exposed will fail. This can often be determined by observations and measurements in the field (i.e. the angle below which the masses across discontinuities are preserved and above which they have separated by plane failure), or by laboratory testing of representative samples.

Also drawn on this plot are the great circles for the planes which correspond to the dominant populations of data points (poles-to-planes). These represent the dominant structures present within the pit domain under consideration. Any structure whose great circle plots between the great circles of the friction angle and the proposed pit-slope angle will daylight in the pit wall and will be prone to plane failure (see Figure 1). The intersections between the great circles for the dominant structures are marked with a dot. They represent structural intersections in the field. These intersections should not fall between the great circle of the friction angle and the great circle of the proposed pit slope angle, or the slope is subject to failure (Figure 1).

Typical Results

The data in Figure 2 represents 195 structural attitudes within one pit domain obtained from geologic mapping on pit benches. This exercise was initiated to assess the potential for increasing the pit slope beyond 50 degrees in the final pushback of the pit highwall. A five degree increase in pit slope on the highwall would represent a savings of over $1,500,000 in costs of mining excess waste rock.

There are four dominant structures shown in Figure 2. None of them have their down-dip surface exposed in the proposed 55 degree pit slope. There is little risk of plane failure in the proposed increased pit slope. The four dominant discontinuities produce a total of six structural intersections. Two of these intersections plunge into the pit wall away from the proposed pit slope and are of little concern in this analysis (open boxes).
Two of the intersections plunge in the direction of the proposed pit slope (open triangles), but at steeper angles than the 55 degrees proposed. One is almost vertical and one plunges at 62 degrees. This latter intersection represents a limiting angle on stable kinematic conditions. Any intent to increase the proposed pit slope beyond 62 degrees should trigger detailed geotechnical evaluations in order to support steepening the slope beyond its apparent stability limit.

Two of the intersections are shallow and plunge in the direction of the proposed pit slope (open circles). One plunges at only 8 degrees and is well below the assumed friction angle. It is stable. The other plunges at 33 degrees, or slightly above the assumed friction angle. On a new project, this intersection should prompt sampling of representative rocks for laboratory determination of the actual internal friction angle for the rock mass in question. In this case, the available pit exposures were inspected to assess the stability of the 33 degree intersections. No failures were evident, indicating an actual friction angle for the rock mass in excess of 33 degrees.

The slope stability analysis for this proposed pit expansion indicates stable slopes can be expected up to an overall pit slope angle of 62 degrees. The decision was made to increase the pit slope to 55 degrees during the final pushback. This pit is within a few months of completion, 500 ft. below the original ground surface, and no failures have been experienced. Figure 3 shows a portion of the highwall of this pit at the beginning of the final pushback.

**SUMMARY**

The evaluation of slope stability under kinematic conditions is more a geologic issue than an engineering issue. Slope stability analysis becomes an engineering issue once external forces (seismic acceleration or hydrostatic pressure) become factors influencing the kinematic analysis. The above example documents the effectiveness of geologic slope stability analysis in influencing decisions with respect to slope designs in open pit mines. The investment of only a month's time collecting geologic data allowed a decision which saved more than $1,500,000 in waste mining costs without jeopardizing miner safety.

Similar slope stability analyses are recommended for all open pit mine projects. The time spent collecting and analyzing geologic data pays multiple dividends. A complete analysis can not only lead to lower operating costs, but it can also provide documentation for permitting procedures. A thorough analysis of the structural fabric within and adjacent to ore bodies often elucidates ore controls and leads to discovery of faulted extensions of ore bodies, providing further rewards from the investment in a geologic slope stability analysis.

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Greg Ilahn was Chief Geological Engineer for CoCa Mines Inc. for 5 years before the sale of CoCa to Hecla Mining Company in 1991. He was responsible for slope analyses and pit designs of CoCa’s seven open pits in southern California and all acquisition and pre-development projects. He is currently Vice President of St. Mary Minerals Inc., a privately held mining investment company.

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A Model for Relating Coal Mining Impacts to Appalachian Plateau Fracture-flow Ground Water Systems

Anthony S. Scales, CPG 6989

Introduction
Regulatory authorities and mining companies often need to determine if a coal mining operation will cause (or has caused), or will contribute to the loss, diminution, or degradation of ground water supplies. This article describes a simplified potential-impact model for the southwest Virginia coal fields that can be applied to the preliminary assessment of such complaints. This assessment may be applied to other coal mining areas where fracture-flow ground water exists and serve as a guide to designing a ground water monitoring plan.

Flow In The System
Pioneering work by Ferguson (1967, 1974), later expanded by Wyrick and Borchers (1981), defined the nature of ground water in the Appalachian Plateau Physiographic Province. Ground water occurs in, and is transmitted through, fractures in coal-bearing rocks, resulting from stress-relief due to erosional unloading. Figure 1 shows movement of ground water in this system. Ground water originates as precipitation (A), travels through soil and colluvium, and enters stress-relief (and tectonic, where present) fractures (B) in highlands, and then moves downgradient, i.e., downslope, in a stair-step fashion (C), to the valley floor fracture system (D). In southwestern Virginia, it has been shown (Scales, 1987 and Harlow and LeCain 1991) that coal seams themselves may act as aquifers, cleating forming secondary porosity and underclays acting as aquitards, and may alter the down-slope to down-dip flow (such as at (E), where a coal seam intercepts the down-slope movement and directs it down-dip, where it exits at the seam outcrop). Ground water may emerge as contact or colluvial springs (especially near the lower half of ridges), but overall movement is to the streams and underlying fractures. As such, the greatest quantity of ground water is found in the valley-floor fracture system.

Ground Water Quality In The System
Ground water quality, i.e., mineralization, is a function of contact time with rock and coal. As a rule of thumb, ground water encountered at higher elevations is less mineralized than ground water at valley-bottom. However, if groundwater has long residence time in a coal seam, regardless of elevation, such water may be high in sulfates and iron, and often of low pH. Note that the poorest quality water will be found at valley bottoms, where quantity is greatest. The greatest risk of non-mining generated pollutants entering the system is in the valley bottom, where most non-coal development occurs. Further, at depths greater than approximately 300 feet below valley bottoms, highly saline (connate) water may be encountered (Dovel, 1983).

How Mining Impacts This System
Figure 2 shows a classification of ground water supplies developed in this system. They are: Ridgetop wells, the lowest producing wells, but often of best quality; Valley slope wells; Alluvial wells, associated with valley floor alluvium, but not, or only slight-
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longwall mining (4) occurs at relatively shallow depths beneath valley floors, subsidence fracturing of the valley floor fracture system may cause dewatering, and even stream loss.

Summary

Where investigation of potential or alleged coal-mining impacts to ground water supplies is planned, preliminary assessment of possible impacts is aided by the above described model. This assessment can define the scope of the filed investigation, or whether further investigation is necessary by 1) understanding flow in the system, 2) defining how a ground water supply obtains water from this system, and 3) determining if the supply lies in an area potentially impacted by a particular type of mining.

REFERENCES


Anthony S. Scales is Geologist, Virginia Department of Mines, Minerals and Energy, Division of Mined Land Reclamation. The model stated in this article does not necessarily reflect the views of the VA DMME/DMLR.
The Changing Role of the Geologist in Roof Support Control

Ron Wyatt, CPG 4568 and John C. Stankus

"Future Trends in Professional Geology", an article presented by Daniel N. Miller, Jr., originally in 1981 in The Professional Geologist, and again 10 years later in the August 1991 issue, certainly rings true to geologists and mining engineers at the Jennmar Corporation.

Daniel Miller predicts that "digitized data, electronic data processing, and totally automated computer generated maps and scenarios will become the standard mode of operation." To affirm that some of Miller's prophesies have become realities, the authors cite the collection, compilation, and utilization of field data as it relates to roof support products in the mining industry.

Jennmar Corporation provides roof support geology and engineering for users of its roof support products in the mining industry. Our approach to roof support geology and engineering is interdisciplinary with teaming of the observational skills and lithologic knowledge of the geologist and the technical expertise for roof support design of the mining engineer.

The geologist and the mining engineer are at the mine site together collecting in-mine data from observations and testing. The geologist's observations are taken from the strata scope examination of the immediate mine roof along with a review of rock cores taken as near to that area of the mine as is available. In addition, actual roof strata samples from roof falls are also viewed. The geologist's role in these observations is to try to identify zones within the strata where mechanical support is necessary.

Stratascope studies are carried out by inserting a flexible stratascope into a 20 foot deep borehole drilled vertically in the mine roof. During the stratascope examination, visual observations are recorded in note form and also by 35 mm Strataphotos (sm)* or VCR Stratavideo (sm). The Strataphoto (sm) and the Stratavideo (sm) provides a permanent record for subsequent analysis away from the site. Using the above techniques, the geologist determines at what horizons separations and fractures to the strata occur. Additional confirmation is provided by rock cores. Strata from actual falls are also examined again for possible signs of where slippage or falling has occurred within the strata.

One of the main concerns of the mining engineer is the anchorage capacity as obtained from pull tests at different horizons within the roof strata. Pull tests are conducted by installing a roof bolt in the normal manner, but with the addition of a pull collar. The collar enables a
hydraulic ram to be attached to the roof bolt. Load is then applied to the bolt while the bolt head deflection is measured.

The data collected by the geologist and the engineer is entered into a database, which is subsequently accessed by a computer program called Jennmar Roof Control CADD (JRCC). JRCC was conceived by a mining engineer and written by a geologist. Working together insured that the finished product would be compatible to both groups of users. JRCC was written in an artificial intelligence language, a superset of common lisp. The software is within a standard graphics software. JRCC receives its data from a database written in a popular Xbase software.

JRCC was developed and copyrighted by the Jennmar Corporation to provide the following output from the in-mine measurements to the geologist and mining engineer:

1. Composite columnar sections.
2. Pull test graphics.
3. Planimetric and cross sections of roof support designs.
4. Bolting geometry, numbers, safety factors.

Each of the above is illustrated in the figures below.

Figure 1 illustrates the result of seven stratascope observations of the immediate mine roof of a coal mine in western Pennsylvania. The name of the mine has been changed.

Pull test data are graphically illustrated in Figure 2. These values are the result of pull tests on roof bolts in the mine area where the stratascope tests were also conducted.

Figures 3 and 4 are views in plan and cross section of supplemental roof control plans.

JRCC has been used for the past two years, and the following observations can be made:

1. Once in-mine measurements are made, computer analysis is quickly provided for safe, economical roof control plans, which are then rapidly drawn by the computer.

2. Interaction by the geologist and the mining engineer are necessary to a high degree to insure realistic results.

3. The geologist's observations of weak strata and zones of separation are the key to support calculations and design considerations by JRCC.

Although Daniel Miller's full prophecy that "Digitized data, electronic data processing, and totally automated generated maps and scenarios will become the standard mode of operation" has not yet been fulfilled at Jennmar Corporation, it is certainly apparent that much of his prophecy is actually being realized.

Looking ahead, it requires little imagination to see that in-mine measurements may ultimately give way to geophysical techniques that Jenn-
mar Corporation obtains through in-mine observations by its geologists and the mining engineers. This could reduce both the geologist and the mining engineer to more of an analyst of automated data, as Daniel Miller has so aptly predicted will ultimately happen. Although the authors are not pleased with this prospect, they agree that it will come to pass in the not too distant future.

Ron Wyatt is presently a full-time consultant to the Jennmar Corporation, Pittsburgh, Pennsylvania, specializing in computer applications in mining and geology. John C. Stankus is the Chief Mining Engineer for the Jennmar Corporation, Pittsburgh, Pennsylvania, in charge of research and development of mine roof control products and field consultation involving the use of the Jennmar Roof Control CADD System.

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SUPPLEMENTAL ROOF CONTROL PLAN
MINE NO. 24

Figure 4

U.S. Coal Production Passes Record Billion Mark

The Illinois Coal Update (Spring, 1991) reports that coal production in the United States eclipsed the 1 billion ton mark for the first time in 1990.

A total of 1.035 billion tons of coal was produced, exceeding the 979.5 million tons produced in 1989, according to the National Coal Association. The nation maintained its rank as the world's top coal-producing country.

Production in Illinois was 60.3 million tons (mt) of coal, surpassing the 59.7 mt mined in the state in 1989.

Other top coal-producing states in 1990 were Wyoming, Kentucky, West Virginia, and Pennsylvania.

Oregon Department of Geology and Mineral Industries

Placer task force releases final report

(December 1991) The Oregon Placer Minerals Technical Task Force has released its final technical report detailing the results of mineral-resource and environmental investigations conducted during 1990-91.

The task force was established in September 1988 to study the economic and environmental aspects of the possible development of "black sand" deposits offshore southern Oregon.

The task force's final report is entitled Preliminary Resource and Environmental Data: Oregon Marine Placer Minerals. The 231-page document includes sections on geology/geophysics, mineralogy/geochemistry, mineral processing, environmental geochemistry, and biology and a section with conclusions. It is published as Oregon Department of Geology and Mineral Industries Open-File Report O-91-2 and is now available at the Department, 910 State Office Building, 1400 SW Fifth Avenue, Portland, Oregon 97201-5528. The price is $10. Orders may be charged to credit cards by mail, FAX, or phone. FAX number is (503) 229-5639. Orders under $50 require prepayment except for credit-card orders.
The Real Cost of Heap Leaching

Howard T. Urband, CPG 4602

In recent years, the number of heap leach gold operations has increased dramatically. The most common reason for selecting heap leach over more conventional extraction methods is low capital cost. Heap leach mines are currently producing a sizeable proportion of the output in the U.S., but the economic advantage of heap leach can be overrated.

The secret to a profitable venture, be it heap leach or other, lies in obtaining and maintaining a good cash flow. This means getting the predicted recovery within the time frame that was expected. A number of heap leach operators have found that eventual recoveries may be consistent with metallurgical test results but the time required to get it is much longer than the tests predicted. Here is why.

Tests usually show what happens when the typical ore is continuously wetted with constantly reinforced solutions. Heaps, on the other hand, are treated somewhat differently. Once the first lift is laid down, solutions are applied. It may take some time to wet all of it and there is a limited time that leaching can occur because the drippers or sprays will be moved to another area while the next lift is added. Consequently, various locations on the heap receive differing quantities of leach solution and are not actually under leach for the same time periods. This means that one spot in the heap may be essentially leached out while another has given up a lesser part of its contained gold.

A second problem is that of gold mobilization. Once the ore fragment is wet, the fine gold is probably dissolved. Now the problem is getting it to a surface where it can be washed off. In the test column, the solutions were continually moving. In the heap, one must rely on the wetting and drying cycles to "wick" the gold out of the rock. The time required may be different than the metallurgical tests showed.

In this writer's experience, gold was still coming out long after the detox mode was started. It kept coming even after the cyanide levels were almost too low to measure and pH was near neutral. This gold was not a bonus but was the same gold that was expected many months earlier during active leaching.

A third problem is solution contamination. During the tests, fresh solutions are introduced, then thrown out after the tests are concluded. In a zero discharge heap, the solutions are reused over and over. If some minor constituent is gradually contaminating the solutions, the solutions eventually will not be the same as those used for the tests, and the leaching results may not be the same either.

Even though predicted recoveries are eventually achieved, the time factor may be off, and this seriously changes the cash flow. Before the development decision is made, it may be worthwhile studying the heap dynamics for the planned operation more closely. The geologist should look very carefully at the mineralogy to determine what, besides gold and silver, will be dissolved over time. It may be that an alternative extraction method could be more profitable than the seemingly simple and inexpensive heap leach approach. A careful comparison is necessary. Heap leaching isn't always the most profitable way to go.

Howard T. Urband is the Vice President of the Vanderbilt Gold Corporation, Las Vegas, Nevada.

NEXT ISSUE

MINING GEOLOGY - PART 2

- Arizona Strip Uranium Mining District, Northern Arizona
- Current Trends in Mineral Exploration and Mine Development in Latin America
- The Mining Environment
- The Sleeping Giant Wakes
- Mine Planning to Marketing By Computer
AIPG 1992 ANNUAL MEETING

SOUTH LAKE TAHOE, NEVADA
September 27 - 30, 1992

THEME: GEOLOGICAL REASON, A BASIS FOR DECISIONS
AFFECTING SOCIETY

HIGHLIGHTS:

- Five technical sessions over three days (Monday - Wednesday)
- Business meetings scattered from Monday - Wednesday
- Five field trips, tied to theme sessions
- Three workshops, one tied to field trip
- Keynote Speaker: T S Ary, Director, U.S. Bureau of Mines

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Aggregate Handbook Now Available

The National Stone Association's brand new Aggregate Handbook - an exhaustive five-year project - is off the presses! It is now available at a cost of $30 for NSA members and $50 for non-members, according to NSA President, Robert G. Bartlett.

The Editor-in-chief of the 16-chapter, 800-page resource volume is Dr. Richard Barkdale, Georgia Institute of Technology. Robert McKeagney, CPG-931, Vulcan Materials Co., served as Project Chairman. NSA Vice President of Engineering, Charles A. Pryor, was the Project Coordinator.

An outstanding group of authors, representing a broad range of expertise, have written or co-authored the various handbook chapters. They include the following AIPG Members: Chapter 4, Geology and Exploration, Jim Dunn, CPG-1347, Dunn Corporation; Chapter 5, Environmental and Community Concerns; Phil Berger, CPG-1896, GeoSonics, Inc.; Chapter 6, Industry Health and Safety, Rick Renninger, CPG-1738, NSA staff.

To place an order for the Aggregates Handbook, contact Mr. Pryor at NSA's Washington, DC headquarters, 1-800-342-1415.

MINING IN THE COMMONWEALTH

EXCERPT FROM

FAR EASTERN MINERAL RESOURCES:
RUSSIA'S GREATEST POTENTIAL

Experts feel that the Far East economic region has the highest potential for bringing in monetary revenues for mineral resources of any area in Russia. The region occupies an area of 6.2 Mn square kilometers and is made up of the Primorje and Khabarovsky territories, the Yakutia, Amur, Sakhalin, Kamchatka and Magadan regions, the Chukotka and Koryakia autonomous districts, and the Jewish autonomous region.

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The MINING IN THE COMMONWEALTH report is available for subscription. Call Lester Dryer at (303) 753-9250 (in Colorado), or 1-800-729-9250
AIPG Comments to Committee on Environmental Research - Public Forum

The following comments were presented January 15, 1992, at a Public Forum at the National Science Foundation, Washington, DC, held by the Committee on Environmental Research, of the Commission of Life Sciences, National Research Council. They were presented by Executive Director Knight on behalf of AIPG.

The American Institute of Professional Geologists appreciates this opportunity to comment on the organization, management, and support of environmental research in the United States. I convey to you the compliments of our Executive Committee, and especially of our President, Dr. Daniel N. Miller, Jr., who regrets that he was unable to appear here before you. (It will be recalled that Dr. Miller served as State Geologist of Wyoming for twelve years before serving two years as Assistant Secretary for Energy and Minerals in the Department of the Interior). Many of the comments which I am about to present are his.

A substantial number of our Members who work specifically in environmental research will be very interested in your prioritization of research needs. Many will wish to make some contributions as it develops.

As you are all aware, each environmental setting is an integral part of the earth; i.e., the lithosphere, hydrosphere, and atmosphere. Geology is the study of the earth. Therefore, we believe that any research into environmental matters must involve its geological implications. Much of the research for which this Committee will be responsible depends on "geology" and the interpretation of geological data, representative sampling methodology, surveys, maps, etc., and the interaction of flora and fauna with their geological environment.

Therefore, we regard it as essential that Certified Professional Geologists be involved in every step of this research. In your own experience, I am sure each of you has seen the unhappy results of failing to adequately consider particular aspects of your own scientific discipline in a research endeavor. Based on such experience, you will certainly not want to overlook the aspects of geology that only a well-qualified and experienced geologist can recognize and interpret.

Please be assured that the American Institute of Professional Geologists stands ready to assist you in finding qualified and competent geologists to help throughout all of your environmental research activities. Further, we will be most pleased if given the opportunity to recommend one or more highly qualified geological representatives to add to your Committee membership.

As to the environmental problems that we feel are not currently being adequately addressed, we see the following:

• We believe that many environmental problems and misunderstandings are the subject of "overkill" in legislation and regulation before the nature and extent of the problem is adequately researched. Thus, we see millions of dollars of public funds spent on activities that are inappropriate to the problem, or even counterproductive. Meanwhile, other problems, that may be more severe, are virtually ignored. Examples of activity based on inadequate research, in the view of many of our Members, include: some of the regulations governing asbestos and radon; and some of the concerns related to global warming and to pesticides, herbicides, and fertilizers in soil and ground water. How can these, and other, resources be used to benefit man and his environment to a healthier condition (albeit changed) than it now is?

• We believe that there is inadequate research of natural and man-induced geologic hazards, particularly as related to the interaction of flora and fauna with their geologic environments. (We are especially concerned at this time with the various wetlands environments. But, there are others.) For example: What flora and fauna, under what conditions, are beneficial to what types of geologic environments? How? How are erosion, transport and redeposition detrimental to flora and fauna? Why? and How are they beneficial? and Why? How can this information be used?

There are fragmentary answers to all these questions and problems that are nationwide in scope, as well as many others. But, much more research is certainly needed.

As to the most important environmental problems requiring study in the next one or two decades, we believe that the problems discussed above are more than sufficient to occupy our research capabilities for many decades to come.

As to the major problems with the funding, structure, and organization of environmental research in the United States, we would make the following observations:

• We have observed that man, in his arrogance, often behaves as though his influence on the history of the earth and the life which it supports is overriding and permanent. As students of natural history, we know that the influence of any species on the environment, whether local or global, is relatively insignificant and quite temporary. Historical geology has taught us that the great changes which man thinks he sees occurring in his environment, and for which he takes the credit -- or the
blame -- have happened before and are likely to happen again. We recognize that all physical environments and the species which inhabit them are but temporary things.

- Experience has demonstrated to us that much research conducted in laboratories, with inadequate field research, has led to numerous errors in interpretation. This has been wasteful of research funds and has retarded the evolution of all sciences. The result has been the initiation of environmental programs of which some have been, at best ineffective and at worst counterproductive. We believe that real field relationships must be observed and interpreted in the field by experienced field investigators if the research is to be credible and useful.

- Much of the funding seems to be self-serving. There appear to be political agendas that determine not only the subject matter, but the results of some research projects. We encourage the Committee to be diligent in its oversight to prevent this.

- The structure and organization of environmental research, again, seems too often to follow political, rather than scientific, agendas. There seems to be an "old boy/girl" network in research that frustrates the development of new research ideas. This hearing is a salutary development in efforts to overcome this.

We have the following suggestions to improve the research climate and to overcome the problems we have identified above.

- Give more attention to researching ways to accommodate to the ongoing changes in our environment and less to trying to prevent change.

- Place more emphasis on field observations and experiments, conducted by experienced field personnel. It seems obvious to us that all such field work should fully utilize the abilities of highly experienced personnel in the earth, life, and social sciences as well as those in engineering and the more basic sciences of mathematics, physics, and chemistry.

- Involve more people who deal first-hand with the subjects of the research. Include in the research teams persons who have recent direct field experience in dealing with the environmental problems being researched. Thus, persons from industry, both large and small, should join those from government and academe and, all should be listened to. The Small Business Innovative Research program of the Small Business Administration is a possible model. Experience has shown it to be very effective and relatively inexpensive. It can quickly eliminate projects that are "going nowhere" so that funds can be concentrated more quickly on projects that show promise. Parallel projects, carried forward by contrasting researchers, might be funded, with the intent to identify multiple ways of handling the same problem, from different points of view. Thus, we would encourage exploiting the concept of multiple working hypotheses.

Thank you for this opportunity to express our interest and concerns.

William V. Knight, CPG-1535

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**Employment and Compensation Survey
Response Overwhelming**

The response to the AIPG 1991 Employment and Compensation Survey was both overwhelming and gratifying. The number of responses was nearly triple that expected. Consequently, it is taking longer to record and analyze them than was anticipated.

Comments as to the organization and structure of the survey and the individual questions are being noted. These will be taken into consideration when the next edition of the survey is prepared.

Meanwhile, please be patient. Preliminary indications are that the results promise to be very revealing and useful. They may include some surprises!*

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\begin{align*}
^{18}O/^{16}O & = 13C/^{12}C & D/H \\
^{18}N/^{14}N & = ^{34}S/^{32}S
\end{align*}
\]

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MARCH 1992 • The Professional Geologist • 23
FL H 2097  AUTHOR: Davis  
TOPIC: ENERGY  
SUBTOPIC: OIL, GAS, PETROLEUM  
SUMMARY: Creates the Natural Gas Pipeline Siting & Regulatory Act to establish a centralized & coordinated permitting process for the location of natural gas pipeline corridors & the construction & maintenance of natural gas pipelines; includes natural gas pipeline companies in a list of entities having eminent domain authority; provides rate-setting procedures for natural gas intrastate transportation & sale.  
STATUS: 1/28/92 INTRODUCED.

FL S 1950  AUTHOR: Childers  
TOPIC: ENERGY  
SUBTOPIC: OIL, GAS, PETROLEUM  
SUMMARY: Relates to natural gas pipelines; creates the Natural Gas Pipeline Siting & Regulatory Act establishing powers & duties of the Dept. of Environmental Regulation.  
STATUS: 1/28/92 INTRODUCED.

GA H 1477  AUTHOR: Lane  
TOPIC: RES. MGMT. & PRESERVATION  
SUBTOPIC: WATER SUPPLY & PRESERVATION  
SUMMARY: Relates to the licensing of water well contractors; provides for a program of continuing education.  
STATUS: 2/5/92 INTRODUCED.

HI H 3023  AUTHOR: Khano  
TOPIC: BUSINESS & CORPORATIONS  
SUBTOPIC: SPECIFIC INDUSTRIES, OCCUP.  
SUMMARY: Relates to licensing of engineers, architects, surveyors, & landscaping architects; provides powers & duties of board; provides qualifications for licensure.  
STATUS: 1/24/92 INTRODUCED.

ID H 618  AUTHOR: Comm. on Resources  
TOPIC: RES. MGMT. & PRESERVATION  
SUBTOPIC: ANIMALS & WILDLIFE  
SUMMARY: Deletes the requirement that the Director of the Dept. of Water Resources must be a licensed civil or hydraulic engineer.  
STATUS: 2/12/92 INTRODUCED.

IA S 2165  AUTHOR: Comm. State Gov't.  
TOPIC: BUSINESS & CORPORATIONS  
SUBTOPIC: SPECIFIC INDUSTRIES, OCCUPATIONS  
SUMMARY: Relates to the standards of conduct for professional engineers & land surveyors.  
STATUS: 2/19/92 INTRODUCED.

KS H 2899  AUTHOR: Comm. on Envr. & Natural Resources  
TOPIC: ENVIRONMENTAL PROTECTION & POLLUTION CONTROL  
SUMMARY: Relates to oil & gas; concerns disposal wells.  
STATUS: 2/4/92 INTRODUCED.

KS S 677  AUTHOR: Comm. on Energy/Natural Res.  
TOPIC: ENERGY  
SUBTOPIC: OIL, GAS, PETROLEUM  
SUMMARY: Concerns oil & gas; relates to abandoned wells.  
STATUS: 2/13/92 INTRODUCED.

KY H 404  AUTHOR: Dekins  
TOPIC: ENERGY  
SUBTOPIC: OIL, GAS, PETROLEUM  
SUMMARY: Requires a permit for oil or gas drilling to designate the exact location of the well; requires the permit for oil or gas drilling to expire after six months, rather than one year, if the operation has not commenced; allows the permit to be extended 60 days under certain conditions; requires an application for an oil or gas drilling operation be accompanied by a geological map showing the location of oil or gas well & all existing & reasonably projected underground mines within one-half mile of well.  
STATUS: 2/4/92 INTRODUCED.

KY H 494  AUTHOR: Jones  
TOPIC: BUSINESS & CORPORATIONS  
SUBTOPIC: SPECIFIC INDUSTRIES, OCCUPATIONS  
SUMMARY: Creates board to register & regulate professional geologist; defines terms; creates five member Board of Registration for Professional Geologists consisting of three geologists & one public member appointed by Governor by recommendation, & State Geologist; prescribes terms & conditions for members serving on board; states powers & duties of board; requires board to publish a roster of registered geologists & promulgate a code of professional conduct to be made available to each registrant.  
STATUS: 2/11/92 INTRODUCED.

KY S 196  AUTHOR: Nelson  
TOPIC: POLITICS & GOVT.  
SUBTOPIC: ADMINISTRATIVE AGENCIES  
SUMMARY: Relates to the registration of professional geologists; creates a Board to register & regulate professional geologist; defines terms; creates a five member Board of Registration for Professional Geologists consisting of three geologists & one public member appointed by the Governor from recommendations, & the State Geologist; prescribes terms & conditions for members serving on the Board; specifies education, experience, & examination requirements.  
STATUS: 2/13/92 INTRODUCED.

ME 2825  AGENCY: Board of Certification for Geologist & Soil Scientists  
TOPIC: BUSINESS & CORPORATIONS  
SUMMARY: Increases the examination fees in order to provide sufficient funds for testing administration for geologists & soil scientists.  
AGENCY CONTACT: Sandra Leach, State House Station #35, Augusta, ME 04333, (207)582-6723  
CITATION: [UNCODED] Chapter 2 Review of Applications for Certification  
PROPOSAL DATE: 02/22/92  
COMMENT DEADLINE: 02/21/92.

MD H 1447  AUTHOR: Van Hollen  
TOPIC: ENVIR. PROT. & POLLUTION CTL.  
SUBTOPIC: ENVIRONMENTAL ISSUES - MISC.  
SUMMARY: Requires an applicant for a permit to drill wells for the exploration or production of gas or oil to apply an application fee, as specified, to formulate an oil discharge contingency plan, & to demonstrate proof of financial responsibility to implement the contingency plan; requires the Dept. of Natural Resources to prepare an environmental impact statement before issuing a permit & authorizing an exception; specifies the contents of the environmental impact statement.  
STATUS: 2/19/92 INTRODUCED.

MI H 5455 & 5496  AUTHOR: Bodman  
TOPIC: ENVIRONMENTAL PROTECTION & POLLUTION CONTROL  
SUBTOPIC: HAZARDOUS & TOXIC WASTE - NON-NUCLEAR  
SUMMARY: Allows string of hazardous waste disposal facilities only in locations where geologic formations are suitable to protect against contamination of useable aquifers; requires certain rules to be reviewed every 5 years & expands available remedies for violations.  
STATUS: 2/6/92 INTRODUCED.

MI H 5544  AUTHOR: Office of Clerk, et al  
TOPIC: RES. MGMT. & PRESERVATION  
SUMMARY: Prohibits the location of mineral leases within one-half mile of a state park.  
STATUS: 1/29/92 INTRODUCED.

MS S 2615  AUTHOR: Welch  
TOPIC: RES. MGMT. & PRESERVATION  
SUBTOPIC: MINERALS & MINING  
SUMMARY: Requires the taxation of mineral or royalty interests which have been separated from the surface estate; provides a rate of taxation on a per acre basis; requires such interests to revert to the surface owner if the taxes are not paid; provides for the mineral documentary tax.  
STATUS: 2/18/92 INTRODUCED.

MS H 2935  AUTHOR: Hall  
TOPIC: ENVIR. PROT. & POLLUTION CTL.  
SUBTOPIC: ENVIRONMENTAL ISSUES - MISC.  
SUMMARY: Clarifies the duties of the Commission on Environmental Quality & the Dept. of Environmental Quality; revises the membership of the Nuclear Waste Policy Advisory Council.  
STATUS: 2/24/92 INTRODUCED.

MO H 1676  AUTHOR: Wheeler  
TOPIC: ENVIR. PROT. & POLLUTION CTL.  
SUBTOPIC: WATER QUALITY  
SUMMARY: Relates to water resources.  
STATUS: 2/6/92 INTRODUCED.

MO H 1707  AUTHOR: Carroll  
TOPIC: BUSINESS & CORPORATIONS  
SUBTOPIC: SPECIFIC INDUSTRIES, OCCUPATIONS  
SUMMARY: Relates to licensing of certain professions.  
STATUS: 2/13/92 INTRODUCED.

MO H 1763  AUTHOR: Molony  
TOPIC: BUSINESS & CORPORATIONS  
SUBTOPIC: SPECIFIC INDUSTRIES, OCCUPATIONS  
SUMMARY: Relates to certain occupations & professions.  
STATUS: 2/20/92 INTRODUCED.

NH 2250  AGENCY: Wetlands Board  
TOPIC: RES. MGMT. & PRESERVATION  
SUMMARY: Clarifies the provisions for municipalities to follow when designating prime wetlands; provides applicants with standards for permitting & mitigation as it pertains to areas designated as "prime wetlands."  
AGENCY CONTACT: Mary Ann Tilton, Enforcement Officer, 64 North Main St., Concord, NH 03301, (603)271-1247  
CITATION: CHAPTER 701 Prime Wetlands  
PROPOSAL DATE: 2/7/92  
COMMENT DEADLINE & MINING: 3/11/92  
HEARING DATE: 3/11/92.

NJ 5019  AGENCY: Dept. of Envr. Prot. & Ergy  
TOPIC: ENVIR. PROT. & POLLUTION CTL.  
SUMMARY: Develops cleanup standards for contaminated sites.  
AGENCY CONTACT: Samuel Wolfe, ERA, Administrative Prog. Officer, Dept. of Environmental Protection & Energy, Office of Legal Affairs, CN 402, Trenton, NJ 08625  
CITATION: NJAC 7:26(b)  
PROPOSAL DATE: 2/7/92  
COMMENT DEADLINE: 3/11/92  
HEARING DATE: 3/4/92.
On the Environmental Front

The Department of Justice (DOJ) Environmental Division has jumped into the property rights fray on the side of the property owner by urging the U.S. Supreme Court to overrule a pre-regulation decision by the South Carolina Supreme Court. The South Carolina case involves a landowner who was barred from building a beachfront home by the State's Coastal Council.

The Trial court awarded $1.2 million in damages, the South Carolina Supreme Court reversed the decision. The case is now before the U.S. Supreme Court.

The DOJ proposed to file an amicus brief supporting the landowner and urged the Court to adopt the view that even when a regulation is aimed at blocking a serious public harm, a landowner must be compensated for destruction of his property. The National Oceanographic and Atmospheric Administration, the Environmental Protection Agency, and the Corps of Engineers are not in favor of the action by the DOJ. However, the DOJ's Environmental Division dismisses the belief that requiring compensation for regulatory takings will automatically undermine regulatory programs. This decision will be most interesting.

A subcommittee for the ASTM Standards-writing Committee is developing four standard guides on site remediation. Task groups will be organized to develop drafts of the following documents:

- Standard Guide to Develop a Conceptual Site Model
- Standard Guide for Initiating Interim Remedial Action
- Standard Guide for Long Term Remedial Action
- Standard Guide for Post Remedial Monitoring

Individuals or organizations interested in participating or helping to draft standards should contact ASTM at (215) 299-5497. Here is a chance for geologic input from AIPG Members involved in site remediation.

Help develop the standards, don't just complain about the lack of them or their content.

In another Supreme Court Case, the U.S. Supreme Court has agreed to decide whether states may establish licensing and training requirements for workers at hazardous waste sites. The case in point are two laws enacted by Illinois requiring crane and hoist operators to be licensed and have at least 40 hours of training by State or Federal environmental regulators, plus 4000 hours of operating experience. A federal trial judge ruled for the state, but the 7th U.S. Court of Appeals ruled OSHA standards preempt even State laws designed to protect workers and the public.

Eyecatchers from the Federal Register

Part 10 - "Articles Conditionally Free, Subject to a Reduced Rate" - HMM!!

New Patents - "Innsensive High Density Explosive" - or - "All Optical Fiber Faraday Rotation Current Sensor with Heterodyne Detection Technique" - Everyone ought to have one of these!!

The Secretary of Interior has extended the rental rate reduction which was announced in the FR on 1/19/89 (vol 54, No. 12) for onshore oil and gas leases issued prior to 1/01/88. The extension is in force until 2/28/93. By extending the reduction for one more year, the Secretary will be ensuring that the Federal leasing program is not a deterrent to exploration, but instead provides an incentive for development of oil and gas resources. That's what it says in the 2/06/92 FR vol. 57, No. 25.

FLASH

Vol. 57, No. 28, 2/11/92, DOE Office of Energy Research
Notice 92-9

This notice is an announcement of interest in receiving special research grants applications for support of training grants. Applications must be received by 3/31/92. Telephone requests for grant packets should be made to (202) 586-8949.

These grants are restricted to the following states and territory:

AL, AR, ID, KY, LA, ME, MS, MT, NE, NV, ND, OK, SC, SD, VT, WV, WY, and Puerto Rico.

The primary objective for the traineeship appointments are: 1) To increase the number and quality of Experience Programs to Stimulate Competitive Research (EPCor) for state graduates with advanced training in energy related disciplines; 2) provide MS and PhD level training and research through active participation in established, ongoing projects of energy research; and 3) ensure that trainees obtain a broader understanding of development and application of energy related research and technologies.

FLASH II

Vol. 57, No. 30, 2/13/92, Part III

You should have this part if you are involved with environmental work. New Rules for EPA.

40 CFR 1 et al

Changes to Regulations to reflect the role of the New Environmental Appeals Board in Agency Adjudications.

This Board now holds delegated authority to hear and decide the following types of cases - appeals on: RCRA, Clean Air Act, Clean Water Act, Toxic Substances Act, Safe Drinking Water Act, NPDES and more.


A Final Note from the Federal Register

By the time you read this, the Federal Highway Administration has held meetings of the Executive Committee for the Intelligent Vehicle-Highway Society of America. Too bad you missed it.
A Politician? Who? Me?

William V. Knight, CPG-153

"Political ability is the ability to foretell what is going to happen tomorrow, next week, next month, and next year. And to have the ability afterwards to explain why it didn't."

- Winston Churchill.

Most geologists, by this definition, are required to have "political ability". You are acutely aware of this if you have ever had to explain a dry hole, an ore body that turned out to be somewhat less than expected, a plume that went the other way, or a landslide that was not supposed to happen.

We usually don't think of ourselves as having "political ability", but the fact is that we exercise this ability every day in some context, whether business or personal. Yet, when it comes to exercising it in the legislative and regulatory arena, we too often tend to shy away. Why? Some judge in the 19th century said, "No man's life, liberty or property are safe while the legislature is in session." More recently, Senator Fulbright is quoted as saying, "We have the power to do anything foolish we want to do, and we seem to do it about every ten minutes." Unfortunately, there is more than a little truth in those observations. Therefore, we have to be vigilant and willing to take the time and make the effort to deal with legislative and regulatory bodies.

As a practical matter, we should start by building solid, ongoing relationships with staff members of Congressmen, Senators, committees, and agencies. Those are the people who provide the advice upon which decisions are made. They generally are more accessible than the elected officials or the agency heads and can spend more time listening to you. When working with them, focus on the issues first, then work the political side. Work with people on both sides of an issue. You may find that one is more supportive than another.

Work especially hard with that one, but never ignore those on the other side. You do so at your peril.

Know your subject well - all sides of it. You have to know what a particular action will do to or for you, certainly. But, you also need to know how it will affect other people and other issues, especially including others in which that person is interested. Know what these are. Be prepared to acknowledge them and try to address them in such a way as to help your cause without hurting theirs. (Help theirs, if you can.) Find a way to demonstrate that support of your position will enhance the position of the one you are trying to influence. This is nothing more than good salesmanship - and good politics.

Of course, in order to do all of this, you need a good understanding of the structure of government, why things are done and how they are done. It does more harm than good to write to, or go into, the wrong committee, agency or elected official's office and deliver a lengthy discourse that more properly belongs elsewhere - or nowhere. You waste their time and your time. Further, you demonstrate to them that you did not do your homework and are, therefore, not credible. It makes little difference to them that you know your subject well. The fact that you do not know theirs is enough to kill you. You only get one chance to make a first impression, so don't blow it by being improperly prepared. This is another of the many reasons why you need to build relationships with staff members. If they know you, they will be much more likely to be forgiving than if you are a stranger to them. But, even then, take care not to embarrass them before their colleagues by presenting yourself poorly in a setting which they arranged for you.

Finally, remember that words and conversation are the cheapest thing politicians have and get. You are only one of many people they see and hear every day. The best and most valuable thing you can give a politician is a supplement to your oral presentation in the form of a short written summary of the key points you want to make.

Robert Strauss is attributed with the remark that "Everybody in government is just like a bunch of ants on a log floating down the river. Each one thinks he is guiding the log, but it is really just going with the flow." As geologists, we should be able to understand that simile better than anyone. And, we should also be able to understand that it is we, who can erect effective weirs in the form of well positioned reason and logic, who are in the best position to direct that flow. But, no one else can or will do it for us. We must do it ourselves.

A politician? Yes. You.

Executive Director's Itinerary
(subject to change)

The Executive Director is visiting various Sections, agencies, campuses, and other organizations. He is talking, listening, and exchanging information and ideas. Members are encouraged to attend these meetings wherever and whenever possible. His itinerary for the next six months, as presently scheduled, is:

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<td>Mar. 1</td>
<td>AGI/GAP Advisory Committee, Alexandria, VA</td>
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<tr>
<td>Mar. 2 - 3</td>
<td>(Tentative) Appraisal Subcommittee, Washington, DC</td>
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<td>Mar. 23</td>
<td>Geoenvironmental Forum, Washington, DC</td>
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<td>Apr. 11</td>
<td>AIPG Executive Comm., Arvada, CO</td>
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<td>Jun. 19 - 26</td>
<td>European Federation of Geologists, Latin Amer. Geological Congress &amp; Spanish Geological Congress, Salamanca, Spain</td>
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<td>Jul. 11</td>
<td>AIPG Executive Committee, Arvada, CO</td>
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<td>Jul. 28 - 31</td>
<td>(Tentative) Council of Engineering and Scientific Society Executives, Detroit, MI</td>
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STUDENTS AND CANDIDATES' COLUMN

Last month we began this service to our Students and Candidates for Certification with an article entitled "What Do Employers Want?" We invited your comments, questions, and suggestions for future columns. This is being written before you have had time to reply. So, as promised, we will talk about

What Is Needed For Advancement?

Having gained at certain mastery of the fundamentals, concepts, techniques, and communication skills expected at the entry level, we are now eager for advancement. What do employers look for?

Well, obviously, they expect one to keep up with developments in the science of geology. Stay current. Read the literature. That does not mean that you have to read every word of every article in every journal. But, it does mean that you need to be aware of, and have some understanding of, current ideas. A renowned geologist once said that he tries to read the abstract and look at every illustration (and read its caption) in every paper in every issue of the principal journal in his specialty field. He tries to supplement this with a review of at least the table of contents in other related journals. He figures this takes him about two evenings a month. He then reads the papers that catch his attention. Other activities include graduate courses (e.g., one per term) and continuing education courses. One state, South Carolina, requires continuing education to maintain registration. Others are moving in that direction. Several of the technical societies in other fields require it to maintain membership. AIPG has such a requirement under consideration. Technical meetings, journal clubs, conventions, and field trips are all ways in which to stay current and to learn what your peers are thinking and doing.

This is expected just to keep your job, whether you want to advance or not. This is part of what it means to be a professional.

Advancement usually means moving into some level of management. Even though you may supervise no one but yourself, if you have some discretion over how money is spent, you are in management. The supervision of other people frequently goes along with this.

Thus, you need to have some understanding of planning, budgets, and project management and controls. Referring again to AIPG’s report, "Education For Professional Practice", we find some suggestions. Among "other courses" we see Accounting, Applied Economics (e.g., Engineering Economics), and Statistics. One might add to this list such subjects as Project Management, Strategic Planning, etc. Most of these are available as electives or audits for undergraduates. They also are frequently available as short courses, as extension or correspondence courses, or in local community colleges.

Ability to work with other people is essential to any significant advancement. We have all heard of the rule that says one advances to his/her level of incompetence. For people who are technically oriented, that level is often reached first in their relationships with others. You need to be able to get people to do what you want them to, and you want to accomplish this with as little effort as possible. Ideally, you will get them to do what you want because you have convinced them that they want to do it.

Understanding and appreciating the differences between people and being able to work within those differences is essential. Foreign language studies serve more than to merely give us the words to communicate with people in other countries. They also should give us some understanding and appreciation of other cultures. Even though we may never visit those other lands, this appreciation carries through to our dealings with our fellows in the workplace. Psychology courses, particularly Industrial Psychology, can be very helpful. Personnel Management generally tends to focus on administraton more than interpersonal relationships, but it can be worthwhile. Again, these subjects are often taught in short courses, seminars, etc., available to the working geologist. Social settings and community and organizational activities are good places to develop "people skills". The dedicated introvert seldom becomes a good manager or leader. But, an introvert need not remain one. It just takes a little more effort to break out of the shell. Scientists seem to be more inclined to introversion than most people. But, it is not necessary to be an introvert to be a good scientist. Benjamin Franklin was a prime example and, in many respects, an excellent role model.

Thus, your local geological society, your political party and other organizations are excellent training grounds. They provide you with both the experience and the "network" to advance your career.

In our next column, we will look at career planning and management. Meanwhile, as we said last month, send in your comments, questions, and suggestions for future columns. If you have particular concerns, we want to know about them. If you would like to be a guest columnist, let us know. Address your correspondence to: AIPG, Editor-TPG, 7828 Vance Dr., #103, Arvada, CO 80003, or FAX (303) 431-1332.

NOW AVAILABLE!

AIPG has two new publications available:

- Education For Professional Practice
- AIPG Student Chapter Operations Manual

Both publications are now available to AIPG Members for $2.00 and $3.00 for non-members. To order mail your payment to: AIPG, 7828 Vance Drive, Suite 103, Arvada, Colorado 80003.
CALENDAR


April 17 - 20, 1993. SEGC Conference '93, Integrated Methods In Exploration and Discovery, Denver, CO. Call for papers and posters. Contact SEGC Conference '93, P.O. Box 571, Golden, CO 80402, USA. J. Alan Coope, Ph.: (303) 892-8534 or (303) 791-7231 or Richard L. Nielsen, Ph./FAX (303) 279-3118.


MEMBERS IN THE NEWS

Lance Duncan, CPG-8127, is now working for the Anchorage office of URS Consultants, Inc. as Senior Project Manager. Lance will be responsible for heavy civil, dam, and mining projects in Alaska, and will serve as Project Manager for the ongoing U.S. Navy CLEAN program in Alaska which is being performed by URS.

A. G. Everett, CPG-2387, is author of Significant Aspects of Ground Water Aquifers Related to Well Head Protection Considerations, which is now available from Water Resources Publications. This publication is 53 pages long, paperback, and spiral bound (ISBN-0-918334-70-5). To order send $9.00 U.S. to: Water Resources Publications, P.O. Box 2841, Littleton, CO 80161-2841 or call (303) 790-1836.

I. K. Gilmore, CPG-8039, was promoted to Chief Geologist at Texasgulf's Phosphate Mining Operations near Aurora, North Carolina.

Mr. Gilmore has been with Texasgulf's Long Range Planning Department since 1982 and has been serving as Superintendent of Mine Planning since October 1988. Mr. Gilmore is a Certified Professional Geologist and a Registered Professional Geologist in North Carolina, South Carolina, and Florida.

Swapan S. Ghosh, CPG-7850, has been named Director of Technical Services of R. E. Blattner & Associates, Inc. (REB), Indianapolis, Indiana. Dr. Ghosh has more than 15 years of professional experience in geologic and environmental consulting. REB is a full service geologic and environmental consulting firm.

Micheal Linden, CPG-8030. In December, Mike left his position as Geologist for the Jefferson National Forest and George Washington National Forest. He was transferred to Albuquerque, NM, in Region 3 of the U.S. Forest Service (Arizona, New Mexico) to become a New Mexico Zone Geologist. Mike's new duties include evaluating mining claims, oil and gas operations, and other mineral resource projects on federal lands in that part of the country.

Victor Oppenheim, CPG-3965, was nominated as International Man of the Year, 1991-1992. This prestigious award - issued by way of proclamation - will be made available to only a few illustrious individuals whose achievements and leadership stand out in the International Community. Nomination as International Man of the Year is made by the Editorial and Advisory Boards of the International Biographical Centre. Victor received the 1991 Outstanding Geologist Award by the Texas Section of AIG in October 1991. He was recognized for his contribution of talent and skill during the early exploration of the South American Continent. He was the first geologist to individually map an entire continent.
Applicants for certification must meet AIPG’s standards as set forth in its Bylaws on education, experience, competence, and personal integrity. If any Member has any factual information as to any applicant’s qualifications in regard to these standards, whether that information might be positive or negative, please mail that information to the Executive Director within thirty (30) days. This information will be circulated only so far as necessary to process and make decisions on the applications.

Full Membership
ASNIE, Jonathan A. 17121 Foley Drive, Yorba Linda, CA 92685. Sponsors: Sam B. Upham, Jeffrey Kubicki, Jeff Jones.
BRELAND, Jack L. 15125 Parkside Dr., Unit #8, Ft. Myers, FL 33908. Sponsors: Kirk Martin, Buzz Walker, Mike Westphal.
GALVEN, Robert L. P.O. Box 807, Grantsville, WI 54846. Sponsors: Sean Muller, Lee Nash, Tony McCurry.
HOLLOW, Linda B. 5022 E. Delhi Dr., Denver, CO 80212. Sponsors: Marilyn A. Nolin, Dean O. Gregg, Bob Cluff.
JAGUCKI, Philip E. 325 Bechtic Ave., Westerville, OH 43081. Sponsors: John lastick, E. Scott Bar, Robert Arko.
KHARB, Joseph W. 227 North Hill Dr., Westminster, CO 80206. Arnold Schmitty, Mary Anne Kusler, Aubrey T. Cambron, Jr.
MC AULHAIR, Frederick M. 12 E. Newview Dr., Bellev, WA 25201. Sponsors: Pat Riley, Mike Mannan, Berke Thompson.
MCCULL, Mike 8540 Rumsa #4, Reno, NV 89509. Sponsors: Ron Parrott, Bady Conely, Cyrus Field.
MOSES, Shaila A. 2220 Rutherford Dr., Caldwell, ID 83605. Greg Maynard, David Goad, Edward Bartels.
RUBES, Michael L. 1816 Ward Ave., 2705, Honolulu, HI 96822. Sponsors: Col. Bradley, Harold & Clark, John Gries.
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VIEAU, David D. 9011 Homestead Lane, Chanhassen, MN 55317. Sponsors: L. Michael Johnson, Keith S. Rooke, Jamie Windall.
WEBER, Anne D. 4900 East 6th Ave., Denver, CO 80220. Sponsors: Jeffery L. Weier, Dana Friedhof-Miller, Dan Lane.
WESTPHALEN, Olaf 286 Berthew St., Medway, MA 01845. Sponsors: Art Lazaro, Doug Simmance, John Hantins.

Candidate for Certification
GROSS, Gayla D. 1897 Westwood Dr., #201, Westlake, TX 76266. Sponsors: A. W. Gerhard Kune, Christopher Koutz.

NEW MEMBERS (Call and welcome as professionals and as members, and make us all proud of AIPG)

BERGSTROM, Douglas J., CPG-8392 3416 Craft D., Ne St. Anthony, MN 55118 (612) 683-6790.
BURCE, Clement H., CPG-8393 1912 Chestham Dr., Carollton, TX 75007. (214) 492-2093.
CLADD, Robert A., CPG-8405 1459 Plumwood Dr., Houston, TX 77014. (713) 776-6350.
CODEN, Larry P., CPG-8396 1017 Moereu Dr., Jefferson City, MO 65101 (314) 761-7925.
CUBERMAN, Robert A., CPG-8406 2318 Table Heights Drive, Goldens, CO 80401 (303) 377-2821.
DAVIS, Scott E., CPG-8395 3096 Village Green Dr., Aurora, IA 50010 (708) 679-9640.
GRETZKY, James E., CPG-8407 1102 Humber, Midland, TX 79005 (214) 880-5863.

NEW CANDIDATES FOR CERTIFICATION

MEICH, Mark L., CFC-0018 320 Timber Trail, Chelsea, AL 35043 (205) 949-7254.
NIELSEN, Robert C., CFC-0019 RR 1, Box 37, Milan, MN 55262 (612) 227-6050.

STUDENT AFFILIATE

LAMBERT, Susan M., CFC-0009 405 S. Sneve Ave., #10, Sioux Falls, SD 57103 (605) 338-0855.

APIG Membership Totals

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MARCH 1992 • The Professional Geologist
CHANGE...

...Everybody needs it.

ATEC Associates, Inc. knows about change...when to invest it and when to make it. We began in 1958 as a geotechnical, drilling and materials testing company. In the early '80's, we expanded our services to help address the world's environmental concerns.

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- Remedial Construction
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