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Technical Session Abstract Book

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Hecla Mining Company
Coeur d'Alene, Idaho

2009 Abstract Book
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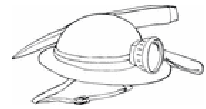

******** Wednesday Morning ********

******** Wednesday Afternoon ********

******** Thursday Morning ********

******** Thursday Afternoon ********

******** Friday Morning ********

NEVADA PROSPECTORS FORUM - PART I

Chairs: **Mark J. Abrams**, *Exploration Manager, Agnico-Eagle (USA) Limited, Reno, NV*
Eric M. Struhsacker, *Senior Geologist, AuEx, Inc., Reno, NV*

The Jarbidge Mining District at One Hundred Years, *John Berndt, Consulting Geologist, Elko, NV*

The Jarbidge mining district in northeastern Elko County, Nevada was discovered in 1909. Between 1918 and 1932 it was one of the important districts of the western United States, having produced more than 355,000 ounces of gold and 1,600,000 ounces of silver from 800,000 tons of ore. All production was from low-sulfidation, quartz-adularia veins in mid-Miocene rhyolite lava flows and tuffs.

Detailed study of the complex volcanic stratigraphy and pre-volcanic to post-ore faults allowed prediction of significant bonanza vein occurrences. Only one target generated by this study has been tested to date and both drill holes encountered the predicted vein. Reported results indicate the vein is greater than one meter true width and gold grades exceed 0.15 to 0.2 opt in the vein.

Future work in the district should be equally interesting.

The Cross Project, Lincoln County, Nevada, *Ken Brook, Desert Ventures, Inc., Reno, NV*

Cross is a gold exploration project in Lincoln County, Nevada on the southern extension of the Cortez (Battle Mountain – Eureka) trend approximately 83 miles south of Ely, on the eastern side of the southern Schell Creek range. The project's geologic similarities to the AuEx discovery at Long Canyon in eastern Nevada prompted a re-evaluation of the Cross data. As a result, significant new areas of gold mineralization have been identified.

The project contains a thick section of Paleozoic carbonate rocks including the Ordovician Pogonip Group, Eureka Quartzite, Ely Springs Dolomite and the Laketown Dolomite. There is a Tertiary granodiorite stock just to the east of the project. Large dikes of granodiorite go out from the main intrusive and into the sediments along a number of west-southwest-trending structures. These structures have brought multiple phases of intrusive rocks as well as gold-bearing hydrothermal fluids into the rocks of the Pogonip Group. This has created jasperoids and zones of strong alteration in calcareous siltstones containing up to 5 gms Au/ton

Structurally controlled gold mineralization is found on the east side of the project in a northerly-trending zone 10,000 feet-long and 2,000 feet-wide along the pediment gravel – Goodwin Limestone outcrop interface. A second zone of gold mineralization is found on the west side in calcareous siltstone beds of the Ninemile Formation. The gold occurs in stratigraphically controlled zones of decalcification, iron-oxide-staining and argillic alteration. The area containing the altered beds is 9,000' X 4,000' in size. Most of the iron-oxide-stained beds within the Ninemile are at or beyond the distal ends of the dikes, and could represent the "distal disseminated" style of gold mineralization.

The Goldfield February-Premier Project – A Buried Bonanza, Esmeralda County, Nevada, *Thomas Temkin, Lode Star Gold Inc., Goldfield, NV*

Lode Star's Bonanza Project consists of a total of 42 mining claims (approximately 600 acres), including 30 patented and 12 unpatented lode mining claims, located in west-central Nevada, in the Goldfield Mining District, approximately one-half mile northeast of the community of Goldfield.

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The oldest rocks within the claims consist of Ordovician siltstones, argillites, and calcareous black shales, all intruded by Jurassic quartz monzonite, and unconformably overlain by Tertiary-aged intermediate flows emplaced during regional volcanic activity 34 to 22 million years ago. The entire project area is covered with up to one-hundred feet of colluvium.

The principal structural features are related to an Oligocene collapsed caldera, producing a ring fault/fracture system. Superimposed on this volcanic center is the regional-scale northwest-trending Walker Lane right-lateral strike-slip fault zone, resulting in a complex fabric of northwest- and northeast-trending, steeply dipping faults that repeatedly cross the claims.

The Goldfield district is one of the most prominent North American examples of the epithermal subclass known as high-sulfidation (or alunite-gold) deposits. Gold-related mineralization is characterized by intense pyritization and low-pH, acid-sulfate hydrothermal alteration of the volcanic host rocks. Bonanza-grade gold occurs in brecciated, quartz-alunite vein-filled faults and fractures.

The work plan currently in progress by Lode Star has included 33,000 feet of combined underground and surface core drilling, over 3,000 feet of reverse-circulation drilling, and an orientation CSAMT geophysical survey. This ongoing exploration program, founded on the reinterpretation of historic work, has resulted to date in the identification of several historically-unknown gold-bearing vein zones containing values up to 75.0 oz/ton gold. This clearly demonstrates the potential to identify new ore zones within the project claims.

Exploration Opportunities and New Mine Development at Borealis, Mineral County, Nevada, *Steven Craig, Consultant, Reno, NV*

Gryphon Gold Corporation controls the Borealis gold mine in Mineral County, Nevada. Borealis had previously produced over 600,000 ounces of gold from oxidized and silicified volcanic rocks. The previous operators left numerous opportunities for discovery of new gold deposits or continued development of known deposits.

Gryphon has conducted extensive geophysical surveys to both identify new targets for drilling or better model known deposits to assist in discovery of new deposits. Geophysical surveys utilized by Gryphon include gradient-array IP-resistivity and CSAMT; both have identified encouraging areas for future drilling. New structural modeling within the main Borealis mine site has provided additional targets near some of the developed deposits.

Funding of future exploration drilling will rely on positive cash flow by developing the Borealis project into a second generation heap leach mine. Construction is currently underway which will produce about 50,000 ounces of gold over 5 years from oxidized ores derived from insitu deposits, old waste dumps and previously leached material. Projected life of mine cash operating cost is $476 per ounce of gold, after tax NPV of $12.5 million, IRR of 27% and payback of 2.25 years based on an $800 per ounce price of gold.

Rio Fortuna's Wind Mountain Gold/Silver Project, Washoe County, Nevada, *E.M. Crist & J.A. Kizis, Jr., Rio Fortuna Exploration Corporation, Reno, NV*

The Wind Mountain project hosts a high-level, low-sulfidation gold/silver deposit in Tertiary volcaniclastics and sinter. From 1989 through the mid 1990's, AMAX Gold produced nearly 300,000 ounces of gold and 1,770,000 ounces of silver from the property. Low strip ratio and excellent metallurgy contributed to the success of the heap-leach mine.

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Rio Fortuna's Wind Mountain Gold/Silver Project... (Continued)

The original intent of Rio Fortuna was to explore deep for the feeder system of the near-surface gold deposit. It is now obvious that potential for a shallow, heap-leach deposit also exists.

A large region with anomalous precious metals has been defined that is more than 3,750m north-south by 1,800m wide. A 43-101 compliant estimate of 406,000 ounces of gold averaging 0.411g/t (Measured plus Indicated Resource, not including nearly 100,000 ounces of Inferred Resource) has been made. While exploring for the deep feeder system, Rio Fortuna discovered what is believed to be the deep, down-faulted western portion of the deposit, which is not included in the 43-101 estimate. Nearly 2 million ounces of gold are indicated to have been contained by the original deposit.

Large undrilled/under-drilled areas remain, which could host additional near-surface gold resources. Potential for high-grade gold/silver exists at depth.

Hycroft Exploration Update, Humboldt County, Nevada, *David C. Flint, Allied Nevada Gold Corporation, Reno, NV*

Allied Nevada Gold Corp. re-initiated exploration of the Hycroft mine property and surrounding lands in June 2009. The program is expected to result in 40,000 meters drilled for the year. The exploration program has been designed to upgrade oxide and sulphide resources to the reserve category, further increase the reserve and resource base, provide data and material to aid in advancing optimization programs and completing a feasibility study for sulphide mineralization. The 2009 drilling will be directed towards Vortex zone in-fill drilling, Vortex step-out drilling and testing selective geophysical anomalies. The program will also focus on collecting representative samples from various areas of the mine to complete further metallurgical testwork on oxide, sulphide and mixed mineralization.

Rosebud Revisited and Reinterpreted, Pershing County, Nevada, *Gregory T. Hill and Robert G. Cuffney, Harvest Gold Corporation, Reno, NV*

Harvest Gold Corporation's Rosebud property is an advanced exploration project consisting of 54 unpatented mining claims centered on the former Rosebud underground mine, which produced 396,842 oz gold and 2,309,876 oz silver between 1997 and 2000. The Hecla/Newmont underground operation mined 953,119 tons in three high-grade ore zones, with an average production grade of 0.416 oz Au/t, 2.42 oz Ag/t. An in-place, non-43-101-compliant inferred resource of 242,000 oz Au, 2,130,000 oz Ag (6.81 million tons @ 0.036 oz Au/t, 0.31 oz Ag/t), was calculated by Hecla at the close of mining in 2000.

The Rosebud deposit is a high-grade, low-sulfidation, volcanic-hosted precious metals deposit similar in age, origin, geologic setting, and mineralization style to other low-sulfidation gold deposits in northern Nevada including the Sleeper, Midas, Hollister, and Mule Canyon deposits.

Mineralization at Rosebud is characterized by structurally-controlled high-grade quartz +/- calcite stockwork and disseminated zones containing minor pyrite, marcasite, and silver sulfosalts. Barite and minor to trace amounts of base metal sulfides are also present. Gold occurs as electrum and native gold.

Geologic mapping and 3D modeling indicate that high-grade zones, surrounded by broad lower-grade halos, at Rosebud are controlled by dilatant structural openings developed within a broad north-northeast striking transtensional fault zone. This structural feature is coincident

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with regional magnetic anomalies interpreted to be associated with mid-Miocene rifting. Several high-grade zones, similar to the compact "Chimney" which contained approximately 40% of the total mined ounces, are likely to exist peripheral to the former Rosebud mine. Numerous high-grade drill hole gold intercepts are present outside of the mined ore zones, leaving good potential for discovery of additional high-grade zones with cumulative potential of >1 million oz Au.

In addition, significant gold was intercepted within drill holes that penetrated the Auld Lang Syne basement rocks just below the unconformity with the Tertiary volcanic rocks. This setting is analogous to gold zones that occur at several Nevada epithermal deposits and is relatively unexplored at Rosebud.

Harvest has identified eleven target zones, about half of which are proposed to be tested through a phase I drill program.

History of the Snowstorm Exploration Project, Northern Elko and Humboldt Counties, Nevada, *Winthrop A. Rowe, Richard H. Fifarek, Elizabeth J. Crafford, and Steven L. Evans, Snowstorm, LLC, Winnemucca, NV*

Snowstorm Project is a privately funded "grass roots" gold exploration project located in the northern Snowstorm Mountains, and extending west to Chimney Reservoir. A large land position covers approximately 31 square miles. Project activities began in early 1999 and have continued to present.

The project was initiated to explore the unique intersection of northern extensions of the Carlin Trend, Getchell Trend, and northern Nevada Rift. Data collection includes 8,066 surface samples with multi-element geochemistry, geologic mapping, structural mapping, imagery, 2,678 gravity stations, and 267,855 ground magnetic stations, and drilling of 57 holes for 69,785 feet of RC and 26,264 feet of core drilling.

Miocene volcanic and volcaniclastic rocks dominate the entire surface exposures of the project area. Drilling of this volcanic sequence has defined lithologic equivalents to typical Midas District stratigraphic host rock units. In addition, drilling and geophysics demonstrate that much of the project area is underlain by Paleozoic rocks at relatively shallow depths. Paleozoic rocks found in drill holes are interpreted mostly as being Comus Formation host rocks, including an interpreted Comus age seamount formed by mafic submarine volcanic activity. Lithologies and stratigraphic interpretations will be discussed in further detail. The structural setting is commensurate with the complexities of four intersecting structural trends. Detailed ground magnetic geophysics has identified a buried intrusive with two apparent age events.

Three different styles of exploration targets exist, as defined by multiple types of exploration data. Target styles include:

- Midas style vein systems
- Miocene age near surface silicification and brecciation
- Turquoise Ridge style targets hosted in limey sediments of the Comus Formation

Each of the three target styles will be discussed. However, the highest priority targets going forward are Turquoise Ridge style targets.

Geophysics, geochemistry, geologic mapping, structural mapping, and drilling information have been integrated and modeled in GIS and 3-D platforms to identify high quality targets.

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NEVADA PROSPECTORS FORUM - PART I... *(Continued)*
History of the Snowstorm Exploration Project... (Continued)

Most significantly, the targeting tools are utilized to outline Eocene age gold targets hosted in Paleozoic rocks that lie beneath Miocene age volcanic cover.

Exploration for new gold deposits along a northern projection of known Nevada gold trends is the intended purpose of Snowstorm Project. The authors are of the opinion that exceptional progress and breakthroughs have been made within the context of this objective.

POWER SESSION I -
THE BUSINESS CASE FOR STRATEGIC ENERGY MANAGEMENT

Chairs: Ann S. Carpenter, *President & CEO, Remote Energy Solutions, Reno, NV*
Luke J. Russell, *Vice President Environmental Services, Coeur d'Alene Mines Corporation, Coeur d'Alene, ID*

Business Case for Strategic Energy Management: "Green-Backs before Green", *Dr. Charles Reith, GMU Professor, Adjunct Professor of Environmental Science & Policy, Maestro Ventures, Vancouver, BC, CANADA*

When and how energy management affects bottom line.

Developing a Strategic Energy Plan, *Ed Birch, President, Strategic Energy Group, Portland, OR*

Some tools to help drive continuous improvement in energy conservation/management with a case study.

The Energy of Politics, *Zack Gorstein , Remote Energy Solutions, Reno, NV*

What's happening on legislation, regulatory developments, etc. that "encourage" energy conservation/renewable and alternative energy deployments.

Energy Management Standards: ISO for Energy Management - WII-FM (What's in it for Mining)? *Jon Feldman, CEM, Managing Consultant, Energy Management, Hatch Management Consulting, Oakville, ON, CANADA*

Why does it seem that many mining leaders are becoming jaded regarding energy conservation? The energy savings that are promised and expected are often not achieved, or if they are, are seldom sustained. At the same time, site staff often complain that they do not receive the support or attention from corporate management. How does a company address these issues and reap the benefits of a successful energy management program?

DON'T FORGET ....
EXHIBIT HALL COFFEE BREAKS -
Mornings - 9:35 - 10:20
Afternoons - 3:35 - 4:20

OPEN PIT MINES - MINING IN CHALLENGING TIMES - EVALUATION & PLANNING FOR MINE OPTIMIZATION

Chair: William B. Goodhard, *Vice President & General Manager - Round Mountain Gold Corp., Round Mountain, NV*

Mine Planning and Pre-development, *Juanita McCord, Senior Mine Engineer 5, Eureka Moly, LLC, Eureka, NV*

The Mount Hope project is a world class molybdenum deposit located 22 miles north of Eureka, NV on Highway 278. General Moly, Inc. (GMI) is developing the project as an open pit mine and conventional mill. GMI is the majority owner and operator of the project.

A primary objective of the mine optimization is the need to balance continuing improvements to the project economics while presenting a consistent plan to the regulatory agencies in support of the permitting process. This essential requirement coupled with the lack of available as-mined data presents a unique challenge to the mine engineering effort.

Proposed Methods for Correlating Fragmentation to Ore Recovery, *Tyler Acorn, Drilling & Blasting Engineer, Newmont Mining Corporation, Carlin Operations, Carlin, NV and* Aaron Burton, *Mining Engineering Student, University of Kentucky, Lexington, KY*

Due to an increase in gold recovery and the surplus crushing capacity at Newmont Mining Corporation's Gold Quarry operations, it was proposed that high grade heap leach material should be crushed. While the costs associated with crushing the material are well known the increased recovery due to the reduced material size is not. Multiple studies have been conducted at the Gold Quarry and other Carlin operations on correlating heap leach gold recovery to better blasting practices and crushing. After reviewing the studies it was discovered that they did not develop an accurate relationship between fragmentation sizing and gold recovery. Without knowing the benefit from smaller material sizes it is difficult to correlate the advantages between crushing and blasting practices for reducing the material size. This paper reviews the methodology that is being used to relate fragmentation size to gold recovery on a heap leach pad at the Carlin operations. The methods discussed herein are still ongoing at these locations to adjust for changing geology, equipment, and technology.

Sharing Maintenance Best Practices Across Different Geographies, *Jeremy Brans, Manager of Operations Strategy, Kinross Gold Corporation, Toronto, ON, CANADA*

Less than one year ago, Kinross Gold Corp. set out on a maintenance improvement initiative. They knew that they spent a lot on maintenance (nearly 30% of opex) and that pockets of excellence existed around the company at different sites, so the opportunity to leverage best practices was enormous. However, the challenges were many: Kinross has five open-pit and two underground mines across four countries speaking four languages. Furthermore, Kinross being a relatively young company, it had never performed a best-practice-sharing project across all of its sites. Finally, it faced sites whose maturity in maintenance work management was vastly different from each other. This talk will detail the first six-months of the project: The visioning, the diagnostics, the development of the Kinross Way for maintenance, and how the many challenges were tackled to roll this initiative out.

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Backfilling Depleted Open Pit Mines with Geomembrane Lined Process Ore Heaps and Waste Fills for Reduced Closure Costs, *Allan J. Breitenbach, P.E, Vector Engineering, Inc., Golden, CO*

Introduction

The major mine disturbance areas related to open pit mining operations include the excavated mine pit limits, the surrounding mine waste dump piles from overburden (non-ore) stripping excavations, and the tailings impoundment or heap leach facilities. The tailings impoundments and leach pads are typically lined in modern times. A partial or complete backfilling of any depleted mine pit areas with these lined facilities, where practical, would significantly decrease the overall mine disturbance footprint, resulting in lower reclamation costs at closure. The post-mining reuse of open pit mine excavations for lined solid waste landfills is a relatively new concept as well in the eastern and western parts of the USA.

The steep pit wall excavation slopes and the natural groundwater conditions above the mine pit bottom limits are the two greatest engineering design challenges to consider in lining and backfilling an open pit mine excavation. Several mine pits have been lined and backfilled for solid waste landfill and tailings impoundment slurry disposal operations in recent times. Several lined mine pit heap leach designs have been considered in the past, however there are no known lined mine pit heaps being constructed to the present day. An example of an active open pit mine with surrounding perimeter waste piles, tailing impoundment and leach pad facilities is shown in Photo 1.

This article will present case history examples of the recent lined and backfilled mine pits for solid waste landfill and tailings impoundment disposal, as well as the general engineering design considerations for potential backfilling of lined mine pits for waste disposal and ore heap leach operations.

Case Histories of Lined Facilities in Mine Pits

General

The open pit mines have historically been left in an open condition during operations to closure, unless unstable wall conditions warranted partial backfilling to complete the pit ore excavations. In some cases, the pit bottom limits were partially backfilled to above the natural groundwater level, where practical, to prevent ponding of water at closure or to stabilize waste dump slopes around the pit wall limits. Most open pit walls are constructed to a safety factor of 1 to extract as much ore from the ground with the least amount of stripping to expose the ore body.

The backfilling of mine pits with lined landfills, tailings impoundments and heap leach pads, where practical, would significantly reduce the mine disturbance area and related reclamation closure costs. In addition, mine pit backfilling makes efficient use of the excavated storage space with full facility containment within the natural ground versus constructing above ground dams, site grading fills and diversion channels for facility containment. Known case histories of lined mine pit facilities by this author are presented in this section.

Lined Landfills for Mine Pit Backfill

The lined landfill operations in the 1980's included numerous excavated cells constructed below ground level and lined with geomembrane liner, clay soil liner, or a combination of both geomembrane and clay liner as a composite liner system for the disposal of solid wastes. Excavated slopes were generally flattened as required for placement of the compacted low permeability clay soil liner. The excavated cell side slopes were steepened in the 1990's to

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present day, where geosynthetic clay liners (GCL) began to be accepted as an equivalent or better replacement to the clay soil liner. A steepened GCL and geomembrane lined valley wall slope with a flatter conventional clayey soil and liner at the base of the steep slope are shown in Photo 2.

The first abandoned open pit mine quarry excavation to be lined and backfilled with municipal solid waste was the Bristol landfill located in Bristol, Virginia. The open pit quarry included near vertical bedrock walls at more than 300 ft (100 m) high. A mine pit haul road ramp extended from the mine pit rim to the pit bottom for truck access and removal of excavated rock materials, until the mine operations ended sometime before 1990. The mine pit quarry was converted to a lined landfill operation by 1998, as shown in Photo 3 (1997 photo taken from www.bristol.org).

The near vertical rugged rock quarry pit walls were essentially the most extreme engineering challenge known to date for placement of the geomembrane liner system. The rock walls were pre-scaled of loose rock debris and covered with safety wire mesh screen in 1996 and 1997 to prevent rock fall during liner construction and for anchoring the liner system. A layer of geotextile fabric and HDPE geomembrane liner was placed on the lower pit side walls with plans to extend the pit wall liner upward in phases to maintain fully lined conditions above the rising active landfill surface. The mine pit floor was backfilled with a low permeability clayey soil for a conventional landfill bottom composite liner and overlying leachate drainage system.

Lined Tailings Impoundments for Mine Pit Backfill

Several underground mines have been backfilled with tailings backfill since the 1980's for economic, safety or mine closure reasons. Tailings backfill in completed underground mine workings included paste or thickened tailings materials mixed with cement and other stabilizing additives, which reduced the required amount of tailings to be stored in above ground impoundment facilities.

Numerous open pit mines, natural lakes and sea coast areas have been historically backfilled with unlined tailings disposal as well. More mines are adopting the use of compacted earth and rock fill dams with geomembrane liner systems in modern times for tailings disposal with long term containment and improved protection of baseline groundwater conditions. Lined tailings impoundment containment within mine waste piles has been a common practice at several open pit mines in Nevada since the early 1990's. However, open pit mines have not historically been used for lined tailings impoundment disposal until recent times. An example of a conventional above ground lined tailings impoundment contained by compacted earth fill dams in the mid 1980's is shown in Photo 4.

The first geomembrane lined mine pit backfilled with conventional tailings was the El Valle mine pit located in Austurias, Northern Spain. The gold mine pit was depleted of ore adjacent to other on-going nearby active mine pit operations by 2003. In 2004 the bottom portion of the 500 to 1,700 ft (152 to 518 m) deep mine pit was backfilled to above the existing groundwater conditions with a low permeability clayey waste rock site grading fill in preparation for geomembrane liner placement. The clayey mine waste materials were taken from local mine stripping operations to expose the deeper ore materials. The El Valle tailings impoundment at startup of tailings disposal operations is shown in Photo 5.

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The clayey site grading fill in the mine pit bottom limits allowed for dry construction liner installation above the existing or dewatered mine pit ground water levels. Sufficient compacted clayey subgrade fill was placed adjacent to the steep pit walls at startup to allow for perimeter access roads and future lined tailings impoundment expansion raises. A woven geotextile fabric was placed between the geomembrane liner and the clayey rock and soil subgrade to cushion the liner from puncture on the occasional larger cobble sized rocks. The tailings impoundment liner consisted of a 60 mil (1.5 mm) HDPE liner. Tailings disposal within the geomembrane lined impoundment commenced in 2005 with conventional slurry tailings disposal.

Lined Leach Pads for Mine Pit Backfill

This author is aware of only one known lined mine pit leach pad operation to date that was constructed within the open pit limit. The lined pad was constructed in 1984 on a relatively small scale as a pilot test pad in southwest New Mexico, USA. According to mine personnel, the test pad was located in a depleted side pit wall bench area within a larger copper mine pit limit and lined with 80 mil (2.0 mm) HDPE liner. The geomembrane liner was covered with about 5 million tons of low-grade run-of-mine ore dump fill and included sufficient area downhill of the lined pad limits for gravity leach solution drainage to an external lined process pond sump. The pilot leach pad and open pit mine are shown in Photo 6.

Since the 1984 test pad construction, no known lined and backfilled mine pit leach pads have been constructed to date at the bottom of depleted open pit mine excavations. However, there are several copper mines in New Mexico and Arizona, USA considering this option, particularly where mine conditions indicate it is economic to construct for both operations and closure.

Liner Design Considerations for In-Pit Backfilling

General

The primary engineering concerns in lining, backfilling and operating a depleted open pit mine for containment of waste fill or ore heap materials include: 1) installation and protection of the liner below the natural ground water conditions; and 2) stabilizing any steep pit rock wall slopes that are near a safety factor of 1. The major benefits of backfilling with a lined facility include: 1) an overall reduction in required liner area for storage of materials; 2) minimal risk of spills with the elimination of above ground containment dams and watershed diversions (particularly in high seismic earthquake zones); and 3) a significant reduction in overall mine disturbance areas for less reclamation and closure costs. The in-pit liner containment becomes more practical and cost effective, if included early in the operation plans to allow use of nearby stripped mine waste materials for bottom pit site grading preparation and steep pit wall stabilization for liner placement.

The tailings impoundments and leach pad facilities are generally associated with open pit mining operations and located in close proximity to the excavated mine pit and stripped non-ore mine waste pile limits. As the open pit mine is developed, some mine sites have depleted open pit ore zone pockets or multiple open pit sites in close proximity to each other that may be amenable to lining and backfilling for tailings disposal or ore heap leaching. The overall steep pit wall slopes of 35 to 55 degrees with benches in most hard rock mining operations create an engineering challenge for liner systems. Waste rock materials from continued mine overburden stripping operations can provide economic site grading fill to stabilize the floor

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and pit walls for dry geomembrane liner installation with the liner system protecting the underlying groundwater conditions.

The pit wall stability would continue to improve, as lined backfill operations buttress and bury the exposed mine pit wall slopes. Each type of geomembrane lined facility has differing engineering concerns, as listed below.

Lined Landfill for In-Pit Backfill

The municipal solid waste landfills typically require a robust multiple liner system for leachate containment, collection and recovery operations. A drain fill cover and daily solid waste soil cover or temporary synthetic geotextile cover are common for solid waste disposal. Modern landfills within the last 10 years are beginning to apply irrigated water or recirculated leachate flows to the top surface or by deep well injection to accelerate settlement, waste bio-degradation, and methane gas collection (Breitenbach and Thiel 2005). This may require multiple cells and graded gravity flow to sump pump collection locations at the bottom of the landfill for recirculation throughout the life of the facilities.

Landfill liner systems prefer dry ground conditions with deep groundwater levels for no direct connection and transport of any leachate contamination away from the lined facilities. Therefore, most open pit mines would require some type of continuous groundwater dewatering and monitoring system beneath an in-pit liner or the option of mine waste site grading fill to raise the liner subgrade above the seasonal high natural groundwater level conditions.

In general, the lined solid waste landfill for in-pit backfill would include the following major engineering concerns:

- Dry and graded subgrade conditions beneath the liner system with separate drainage cells as required;
- Stable mine pit walls for liner stability and safe access to dispose of waste materials;
- Protection of the liner system from any differential subgrade settlement or puncture;
- Protection of the liner system from overlying waste material placement and puncture with adequate bottom and side wall drain fill or geotextile cover;
- Minimize hydraulic heads on the bottom liner system with a leachate collection and recirculation sump pump system; and
- Design deep sump well systems with redundancy and protection of the liner from the "pile driving affect" of vertical well down-drag forces during waste settlement (side wall wells along the liner slope are optional).

Lined Tailings Impoundment for In-Pit Backfill

The lined tailings impoundment may include storage of several types of tailings waste materials including conventional slurry disposal (about 45 to 55 percent solids to water by weight in a liquefied pipeline slurry discharge), thickened tails slurry disposal (about 60 to 70 percent solids to water for less water pool recirculation back to the plant), and other variations of dry filter and paste tailings transported by truck, conveyor or positive displacement pipeline pumping disposal to the lined impoundment.

Pipeline slurry disposal around the perimeter of the lined impoundment is the most common practice in the mining industry with milled and depleted waste tailings generally consisting of fine grained sand, silt and clay particles. The fine tailings materials form a perimeter sand and silt beach with settled solids forming a water pool in the interior. Decanted water from the water pool is recirculated back to the plant for reuse in operations. In general, the lined

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tailings impoundment for in-pit backfill would include the following major engineering concerns:

- Dry subgrade conditions for liner construction with any required dewatering as needed to maintain the operational tailings beach and water pool surface above the subgrade groundwater level at all times to closure;
- Liner subgrade backfill above bottom groundwater conditions or temporary dewatering is optional, until the lined tailings backfill is raised above the groundwater level;
- Stable mine pit walls for liner stability and safe access to dispose of waste materials;
- Protection of the liner system from any differential subgrade settlement or puncture;
- Partial drain cover above the liner to minimize hydraulic heads on the bottom liner system (optional for maximizing tailings drainage and consolidation) with a bottom leachate collection and recirculation sump pump system; and
- Design the optional deep sump well systems with redundancy and protection of the liner from vertical well down-drag forces during waste settlement (side wall wells along the liner slope are optional).

Lined Heap Leach Pad for In-Pit Backfill

The lined heap leach pad operations differ from solid waste landfills and tailings impoundments in that the liner backfill material is a crushed rock or run-of-mine ore fill placed in controlled lifts and leached to remove precious and base metals in solution for processing at the plant. The ore leaching process requires a fully drained granular ore material or an agglomerated fine grained material that allows percolation of solutions by gravity flow to a sump pump system. Some mines have the ability to provide a gravity solution collection tunnel from the pit bottom to an exterior pond system for pumping to the process plant.

The leach pad can tolerate some exterior hydraulic heads on the liner system (any liner leaks below the groundwater level would allow inflow of groundwater into the heap fill and collection sumps for full containment of solutions). However, any significant dilution of the collected process solutions by external groundwater inflow would be an operational concern in extracting the target metals. Leach pads also require large startup ore lift placement areas for maximizing active leach cycle time to recover the target metals in solution, ideally before the next ore lift can be placed for continued leaching. Copper mines can develop multiple interlift liner raises to optimize solution collection and pump return efficiency (reduce hydraulic head from the pit sump to the process plant). Gold and silver operations require rinsing of cyanide from the spent ore materials, and therefore generally do not operate with interlift liner systems.

In general, the lined heap leach pad for in-pit backfill would include the following major engineering concerns:

- Dry subgrade conditions for liner construction with any required dewatering as needed to maintain low external hydraulic heads on the bottom pad liner system;
- Liner subgrade backfill above bottom groundwater conditions or temporary dewatering is optional depending on the performance of the liner system in preventing any groundwater inflow leaks mixing with the process solution;
- Stable mine pit walls for liner stability and safe access ramps to stack ore materials in controlled lifts by conveyor or truck dumping;
- Protection of the liner system from any differential subgrade settlement or puncture;

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- Protection of the liner system from overlying ore rock material placement and puncture with adequate bottom and side wall drain fill or geotextile liner cover;
- Sufficient startup stack surface area for active leaching cycles (ore lift surface area will increase with each subsequent in-pit lift placement);
- Partial drain cover above the liner to minimize hydraulic heads on the bottom liner system with a bottom leachate collection and recirculation sump pump system; and
- Design the mandatory deep sump well systems with redundancy and protection of the liner from vertical well down-drag forces during waste settlement (side wall wells or tunnel gravity drainage systems optional for solution recovery).

Conclusions

Open pit mines have seen recent use of the below ground excavation limits for storage of solid waste landfill, tailings and ore heap leach fills. The primary engineering concerns in lining, backfilling and operating a depleted open pit mine for containment of waste or ore heap fill materials include: 1) providing dry construction conditions for installation and backfilling of the liner system below the natural ground water conditions; and 2) stabilizing typical 35 to 55 degree steep hard rock mining pit wall slopes that are near a safety factor of 1.

The major benefits of using lined facilities for mine pit backfill include: 1) the overall reduction in required liner area for storage of materials; 2) minimal risk of spills (particularly in high seismic earthquake zones) with the elimination of above ground containment dams; and 3) a significant reduction in overall mine disturbance areas for less reclamation and closure costs. The in-pit containment becomes more practical and cost effective, if included in the operation plans for early use of nearby stripped mine waste materials for site grading preparation and pit wall stabilization during the life of mine.

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LARGE LEFT LATERAL LEAPS FOR ENVIRONMENTAL PROFESSIONALS

Chairs: **Dr. Terry Mudder**, *President, Times Limited, Sheridan, WY*
Lee "Pat" Gochnour, *Principal, Gochnour & Associates, Parker,CO*

Nuclear Confusion, Dr. Terry Mudder*, President, TIMES Limited, Sheridan, WY*

The theme of the 2009 NWMA conference is to open our minds to opening mines. So assume for the moment anthropogenic activity in the form of carbon dioxide emissions is causing a potentially catastrophic change in the climate of Earth. More than 75 percent of the carbon dioxide emissions in the United States come from the burning of coal providing nearly fifty percent of our electrical power. Natural gas fired turbines and nuclear power reactors each account for an additional 20 percent of the electrical generating capacity in the United States. Renewable energy sources such as wind power and hydroelectric dams account for the remaining 10 percent with limited prospect for increases. There are sufficient reserves of either natural gas or uranium available in North America for between fifty and nearly one

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hundred years. Generation of electricity using natural gas in place of coal reduces the overall carbon dioxide output by nearly 50 percent, while nuclear power relying on uranium as the energy source reduces these emissions by almost 100 percent.

Assuming scientific consensus has deemed global warming the Armageddon of human existence, shifting to nuclear power immediately is the only solution even though developing countries have eclipsed the Westernized countries as the leading emitters of green house gases. In the year 2008 China surpassed the United States as the leading global emitter of carbon dioxide. The cost of nuclear power per kilowatt hour is currently nearly on par with coal and natural gas. Reactor designs have improved dramatically over the past quarter century with respect to safety, cost effectiveness, and efficiency by reducing the volume of spent fuel.

Although there has not been a major incidents at a nuclear power facility in the United States for more than a quarter of a century, the accidents at Three Mile Island and Chernobyl still haunt the industry. There have been no new nuclear power plants proposed in the United States since the Three Mile Island accident in 1979. In addition, there are now growing concerns with terrorism and the peaceful reliance on nuclear power as a disguise to hide development of nuclear weapons thereby increasing the existing global arsenal beyond 25,000. The view of nuclear power has transitioned from the "Not In My Back Yard" or NIMBY syndrome of the past to the "Build Absolutely Nothing Anywhere Near Anything" or BANANA syndrome today.

Nonetheless, there are 370 nuclear power facilities in operation today worldwide with 104 in the United States. There are currently over 400 nuclear power plants planned with well over 100 in China and only a couple in the United States. The existing power facilities in the United States each produce about 20 metric tons of radioactive spent fuel annually totaling about 2,000 metric tons. Within the next 5 years the majority of these nuclear power facilities will run out of on site storage capacity for spent fuel disposal. The nuclear power industry in the United States has generated almost 60,000 metric tons of spent fuel to date. The need for a permanent spent fuel storage facility has reached the critical point.

Clowns to the Left of Me, Jokers to the Right…: The Failure of the Nuclear Waste Policy Act, *Mark J. Logsdon, Principal Geochemist, Geochimica, Inc., Aptos, CA*

The United States has operated fission reactors since 1942 and commercial nuclear reactors since 1957. As of 2009, the inventory of civilian high-level nuclear waste (HLW) is approximately 64,000 metric tons of spent nuclear fuel, of which 96% by mass (but only 0.0005% by total activity) by mass is uranium. The radioactive decay products of commercial power reactors, including their decay constants and individual activities, have been studied since the early work of the Atomic Energy Commission (AEC) in the late 1940s and early 1950s. A corollary of this knowledge is that the spent nuclear fuel must be isolated from human and ecological receptors because of the devastating biological consequences of its activity.

The interaction of science and politics in disposal of HLW dates to the 1957 National Academy study for the AEC, commissioned in the very first year of commercial waste generation. 1957 was, of course, the Year of Sputnik, a grand scientific and technical challenge to our country. Twelve years later, we put a man on the moon, but fifty-two years later, we have no repository – or other viable long-term plan – for management of our civilian HLW.

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LLLL FOR ENVIRONMENTAL PROFESSIONALS... *(Continued)*
Clowns to the Left of Me, Jokers to the Right… (Continued)

We achieved our first objective of 1957 in half a generation because we coordinated our national policy with our science and engineering capabilities and kept our eye point he ball. We have failed at the second objective of 1957 for the contrary reasons: we could not establish a real national technical policy, and so were unable to align the science and engineering, and we knocked on.

This tale of woe is the work of eleven Presidential Administrations (six Republican covering 31 years and five Democrat over 21 years) and twenty-six sessions of Congress, executed through 52 years of government, academic and industry research and development, not to mention expenditures of billions of dollars of tax-payers money. All parties – at all times – have claimed Science was on their side, and foresworn politics as a motivation. The record, as we will see, is quite otherwise. Science has been abused and manipulated for political ends, to defend turf (and budgets!), and to prop up dubious assumptions and to animate pet ideas over and over again. The result is the wreckage of the so-called Nuclear Waste Policy Act, but more importantly of an essential element of a national energy policy.

"We have met the Enemy, and He is Us."

LLLL's for ISLs in SD and CO, *Richard Blubaugh, Vice President - EH&S Resources, Greenwood Village, CO*

Uranium mining in the U.S. was virtually shutdown in the early 1980s. However, a few years ago it became apparent to a number of mining folks that the uranium supply was not going to keep pace with the demand, due in large part to the announced intentions of countries like China and India to build large numbers of new nuclear reactors, and also in part, to the advantage of nuclear power of minimizing CO2 emissions due to worldwide concerns about global warming, or climate change. Consequently, proposals for uranium mines, both conventional and *in situ*, have been developed in several of the western states. This presentation addresses the case histories of two proposed uranium *in situ* projects, one in southwestern South Dakota and the other in northern Colorado. In keeping with the theme of the session, large left lateral leaps will be identified as they relate to permitting new uranium mining projects in these two states. Managing these LLLLs also will be discussed.

ALASKA PROJECTS UPDATE 2009

Chairs: **Steve Borell**, *Executive Director, Alaska Miners Association, Anchorage, AK*
Steve Denton, *Vice President Business Development, Usibelli Coal Mine, Inc., Healy, AK*

Coal Resources in Northwest Alaska, *Teresa Imm, Director-Resource Development, Arctic Slope Regional Corporation, Anchorage, AK*

Alaska's North Slope is host to the Northern Alaska Coal Province (NACP), one of the largest untapped coal regions in the world. The NACP extends from west to east in a series of exposures north of the Brooks Range from the Chukchi Sea for 300 miles. Arctic Slope Regional Corporation (ASRC) is an Alaska Native Corporation which owns approximately

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1 million acres within the NACP from the Chukchi Sea to the western boundary of the National Petroleum Reserve-Alaska. Coal in the area has been used by the Inupiat for thousands of years however it wasn't until the early 1900's the USGS began reconnaissance geological studies in the region that the extent of the coal resources became to be understood. There are two Cretaceous coal-bearing formations of fluvial-deltaic clastic sediments that have been identified; the Kukpowruk and Corwin Formations of the Nanushuk Group. ASRC has been involved in evaluating the coal resource potential since the 1980's identifying a potential resource base of 2 billion tons of high-volatile A bituminous coal in shallow synclines within the Kukpowruk and Corwin Formations. Cumulative average heating value for the coal is 7760 kcal/kg with ash ranges of 7% to 20%, sulfur of 0.22% and moisture of 3%.

US Department of Energy Alaskan Coal Activities, *Brent Sheets, Regional Manager, Arctic Energy Office, National Energy Technology Lab (NETL), U.S. Dept. of Energy, Fairbanks, AK*

Alaska's identified coal resource is an estimated 154 billion metric tons, roughly half of the U.S. total. However, this resource has not been economic to develop, with the exception of the Usibelli Mine near Healy, Alaska's only operating coal mine. Major untapped coal deposits exist on the North Slope, in Cook Inlet, and to a lesser degree in discrete areas throughout central Alaska. The USGS estimates that as much as 5 trillion metric tons of coal could remain undiscovered in Alaska, 70 percent of which lies in the North Slope. Alaskan coal has a low sulfur content compared to coal in the contiguous United States.

NETL has conducted numerous studies describing the coal resource and some of the potential uses for Alaska's vast coal reserves. Examples include NETL's collaboration with the Alaska Division of Geologic and Geophysical Surveys to better understand the potential for relatively small coal fields located near remote villages; working with the University of Alaska Fairbanks to design a 20 MW indirect gasifier power plant that might also produce up to 1,000 gallons per month of FT fuel; and engineering and economic studies regarding the potential for CTL plants at two sites in Alaska. An overview of these and several other projects will be presented.

Alaska Airborne-Geophysical/Geological Mineral Inventory Program:16 exciting years of HEM surveying and geologic mapping, *L.E. Burns, M.B. Werdon, R.J. Newberry, D.J. Szumigala, L.K. Freeman, and J.E. Athey, Alaska Division of Geological & Geophysical Surveys, Fairbanks, AK*

The State of Alaska-funded Airborne-Geophysical/Geological Mineral Inventory (AGGMI) program was established in 1992 to acquire geophysical and—where feasible—geological data for about 63,000 sq miles of high perceived-mineral potential, State-interest land. The program is run by the Alaska Division of Geological & Geophysical Surveys (DGGS). Most of the areas contain ≤2% outcrop. Standard products include airborne magnetic and electromagnetic data flown with ¼ mi- (400m-) line spacing and inch-to-mile geologic maps. To date, over 12,000 sq miles of State-interest land with high mineral potential have been geophysically surveyed and 6,430 sq miles have been geologically mapped through this program. Funding for DGGS to conduct similar geophysical surveys for federal land in Alaska with high mineral potential was provided by the U.S. Bureau of Land Management (USBLM) between 1996 and 2008. Through these funds an additional 6,430 sq miles were

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surveyed geophysically. The geophysical data and geologic maps are available to the public at nominal prices, and digital data are available for free through the DGGS Web site (www.dggs.dnr.alaska.state.us) or through FTP.

Integrating geophysical data with detailed geologic mapping has produced significantly improved geologic maps, and enabled extrapolation of units, structures, and geologic ideas far beyond survey boundaries. The geophysical data are used before, during, and after geologic field work. Various imaging techniques, unsupervised/supervised statistical classifications, and other methods targeting specific characteristics of geophysical ± geological data expand our ability to identify probable faults and units, make preliminary comparisons between areas, and identify potential mapping inconsistencies. The advantages the geophysical data provide for geological mappers are tremendous. The improvements in geologic mapping using this method has worked so well that that the same method (detailed airborne geophysical surveys followed up with geologic mapping) is being used for a major infrastructure project in Alaska, the proposed natural gas pipeline route. Over 3,000 sq miles of additional airborne geophysical data were acquired for this project; geologic mapping is currently underway.

The AGGMI program has encouraged mineral exploration by providing a geophysical/geological framework at a useful scale to guide exploration work, and has been strongly lauded by mineral exploration companies and by the Alaska Miners Association. At least one major ore deposit was found because of the geophysical data and the new geologic mapping produced by DGGS. The success of the AGGMI program has led to incorporation of the yearly program into the permanent DGGS operating budget. The AGGMI program will be continuing to produce airborne geophysical data and detailed geologic mapping of high potential mineral areas for many more areas.

Whistler Cu-Au Porphyry Project, *Mike Roberts, Senior Geologist, Kiska Metals Corporation, Vancouver, BC, CANADA*

The Whistler deposit is a Cu-Au porphyry occurrence that is located 170 kilometers to the northwest of Anchorage in the Alaska Range. The deposit is currently defined by a NI43-101 Resource to contain a total Indicated and Inferred resource of 5.75 Moz Au equivalent. Mineralization is hosted by Late Cretaceous diorite porphyry intrusive rocks emplaced into feldspathic sandstones of the Kahiltna terrane. Ore is comprised of classic quartz + magnetite + chalcopyrite ± anhydrite bearing A- and B-style porphyry veins associated with an inner core of potassic alteration. The average grade of the Indicated Resource at Whistler runs 0.87 g/t Au and 0.24% Cu, indicating that Whistler belongs to that unique class of porphyry deposits that contain high Au/Cu ratios. Several “off-deposit” reconnaissance holes which targeted coincident magnetic and IP chargeability anomalies in the “Whistler Orbit”, a 5 by 4 km area largely covered by glacial till, have intersected Cu-Au mineralization and alteration centres that appear to be associated with clusters of porphyry intrusions separate from the Whistler deposit (Raintree West: 160m @ 0.59 g/t Au and 0.10% Cu; Rainmaker: 152m of 0.37 g/t Au and 0.18% Cu). Current exploration, consisting primarily of 3D IP geophysics and diamond drilling, is focused on systematically evaluating these and other off-deposit targets in the Whistler Orbit.

(Alaska Projects continued on next page.)

Update on the Palmer Cu-Zn-Ag-Au Project and the Untapped Potential of the Alexander Triassic VMS Belt, *Darwin Green, VP Exploration, Constantine Metal Resources, Vancouver, BC, CANADA*

Drilling by Constantine on its Palmer Cu-Zn-Au-Ag VMS project in 2009 has expanded the South Wall discoveries (2007/2008) both along strike and to depth. The South Wall includes 3 laterally extensive, subvertically dipping, stratigraphically stacked lenses of massive sulphide-barite mineralization. Step-out drill hole CMR09-23, the first of the 2009 drill season, intersected 21.3 meters of strong stringer and semi-massive sulphide mineralization grading 2.76% copper, 0.50% zinc with higher grade sub-intervals including 11.1 meters grading 3.86% copper and 0.50% zinc. This intersection extends South Wall Zone I mineralization 40 meters down dip of CMR08-17 (27.5 meters grading 2.52% copper, 3.38% zinc, 0.32 g/t gold, 25.5 g/t silver), the westernmost drill intersection in the 2008 drill program. Step-out hole CMR09-24 intersected 9.1 meters of massive sulphide and minor stringers grading 1.90% copper, 5.20% zinc, 0.30 g/t gold and 26.6 g/t silver, within a broader 18.7 meter wide zone of mineralization grading 1.16% copper, 4.16% zinc, 0.30 g/t gold and 29.2 g/t silver. The intersection expands South Wall Zone I, 80 meters west and 40 meters up dip of CMR08-17. At press time, results were available for only 3 of 10 holes completed during the 2009 drill program. A

The Palmer project is located in a very accessible part of southeast Alaska, with road access to the edge of the property and within 60 kilometres of the year-round deep sea port of Haines. It is one of multiple Late Triassic VMS occurrences that define a highly prospective and relatively underexplored metallogenic belt within the Alexander Terrane of southeastern Alaska and northwestern British Columbia that includes both the Windy Craggy and Greens Creek deposits. At 297 million tonnes Windy Craggy is the world's fourth largest VMS deposit by size, and tops the list as the largest of the copper rich (Besshi style) category of VMS deposits. At ~25 million tonnes grading 5.1% lead, 13.9% zinc, 5.61 grams per tonne gold and 706 grams per tonne silver Greens Creek is one of the world's richest VMS deposits (Galley et al, 2007). From a global targeting perspective, the Alexander Triassic metallogenic belt stands out as a premier VMS district to explore for both grade and size

To September, 2009, South Wall mineralization has been extended 380 meters horizontally along strike, and 315 meters vertically down dip. Excellent continuity of thick zones of copper-rich massive sulphide is demonstrated in drilling, including up to 5.1% Cu, 1.79% Zn, 0.29 g/t Au and 20.5 g/t Ag over 15.2 meters within a larger interval of 38.7 meters of 3.16% Cu and 3.6% Zn in CMR08-14. The South Wall with its three distinct stratigraphically stacked zones occurs on the steep limb of a large anticlinal fold, and is correlative with mineralization in the RW Zone that occurs on the shallow dipping upright limb of the fold where CMR07-7 intersected 14 meters of 3.79% Cu, 7.24% Zn. The presence of massive sulphide on both sides of the fold indicates a sizeable massive sulphide system, with zones on each limb offering excellent opportunity for further expansion.

Mineral assemblages reflect metal zoning; pyrite-pyrrhotite-chalcopyrite in massive sulphide lenses and stringers in the stratigraphic footwall to massive chalcopyrite-sphalerite-barite lenses up to 30 m thick, with peripheral barite and/or carbonate dominant sphalerite-chalcopyrite mineralization. South Wall mineralization occurs within a basalt dominated volcanic sequence that includes lesser amounts of rhyolite, and argillaceous and limy sedimentary strata, with a common association between baritic massive sulphides and rhyolite flows.

(Alaska Projects continued on next page.)

Money Knob Deposit, Livengood Project, *Jeffrey A. Pontius, President and CEO, International Tower Hill Mines Ltd., Highlands Ranch, CO*

International Tower Hill Mines acquired 100% of the Livengood project from AngloGold Ashanti in August of 2006 and has been aggressively exploring the project for the past 3 years. This work has yielded a major new bulk tonnage gold discovery which now tops 10 million ounces of contained gold making it one of the largest new discoveries globally over the past decade. The mineralization has been described as stratiform/sediment-volcanic hosted within a thick sequence of Cambrian and Devonian age rocks. The mineralization is intimately related to a large fold thrust complex and contemporaneous with the emplacement of 90 Ma dikes and sills. The thick continuous nature of this shallow, low angle ore body makes it highly favorable for bulk mining and processing. The deposit as currently defined is open in a number of directions and the Company continues with its resource expansion drilling program to assess how big the gold system may be as well as focusing on higher grade zones within the deposit. The Livengood gold deposit lies adjacent to the Elliott Highway, a paved all weather highway, 70 road miles northwest of Fairbanks, Alaska.

GROWTH COMPANIES INTO 2009 - PART I

Chairs: **Ralph R. Noyes**, *Investment Advisor, Coeur d'Alene, ID*
James D. Frank, *Chairman, JDF Consulting LLC., Hayden Lake, ID*

A Nevada Hectorite Being Developed as a New Opportunity for Lithium in Supplying the Demand for Batteries for Electric Vehicles, *Dennis P. Bryan, Senior Vice President of Development, Western Lithium Corp., Reno, NV*

Western Lithium Corporation (WLC) is advancing development of a North American based reliable and scalable strategic lithium deposit to power today's hybrid/electric cars and mobile devices. Lithium-ion is fast becoming the battery chemistry of choice because it produces some of the most powerful rechargeable batteries available. Lithium-ion batteries have considerable advantages over most other battery technologies because of their superior power and energy densities; which equates to lighter weight, greater driving range, faster charging times and faster acceleration. In addition the batteries have no "memory effect" and therefore they may have a longer operating life.

The last decade has seen a significant amount of development work on lithium batteries for vehicles, which has been greatly enhanced by efficiency and safety improvements in lithium batteries for portable electronics. Prices for these vehicles have started to decline and are expected to drop considerably with the mass adoption of electric vehicles providing economies of scale and government subsidies providing increased incentives in the short term. Lithium demand is expected to increase by orders of magnitude due to the anticipated move to electric vehicles. The majority of current lithium production worldwide comes from brine deposits from salars in the high Andes of South America.

The lithium is found as part of a world class deposit of hectorite clay found in the Late Tertiary McDermitt caldera in northern Humboldt County, Nevada. The clays are incorporated in lacustrine "moat" sediments formed within the collapsed caldera between the caldera wall and resurgent interior rhyolite domes. Lithium was believed to be introduced into the sediments

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by hot springs or hydrothermal leaching of nearby rhyolitic volcanics anonymously high in lithium.

Lithium was originally identified in the area by the USGS in the late 70's. Chevron Resources, exploring for uranium in the area, further delineated the lithium in the 1980's with a drilling program which identified a potential resource of approximately 2 million tons of lithium.

WLC acquired the property in recent years and has undertaken both confirmation and in-fill drilling and evaluation that has confirmed some of Chevron's original estimates. Ongoing exploration has further refined the deposit model and ore types present. Extensive metallurgical testing and engineering evaluation is currently underway to assess the economics of producing lithium from hectorite.

UNDERGROUND MINING - PRACTICAL SOLUTIONS TO MINING IN THE MODERN WORLD

Chair: **Nigel Bain**, *Manager, Goldstrike Underground Division, Barrick Goldstrike, Inc., Elko, NV*

Deep Post – End of an Era, *Katie Reed, Mine Engineer, Newmont Mining Corporation, Elko, NV*

Newmont Mining Corporation's Deep Post Mine, located along the Carlin Trend in Eureka County, Nevada, is facing closure the end of 2009. After producing the first ounce 10 years ago, the Deep Post Mine has faced challenges and celebrated successes over its lifetime. A review of the geology, mining methods, equipment and production profile will be a fitting tribute to this world-class deposit.

Wiring Your Company for Sustainable Front Line Improvements, *Keith Russell, Partners in Performance International, Atlanta, GA*

Companies each have their own culture and processes which determine likely performance levels. Unless these are changed, improvement programs are likely to deliver only short term results before things settle back into the as-you-were mode. 12 Years of implementing sustainable improvements in large organizations has led PIP to develop a structured process for fixing those shortfalls – fixing the 'wiring' we call it. 'Wiring' – the systems, processes, procedures, controls, culture which makes organizations work – is the DNA of an organization. Wiring is difficult to see, but it is felt. In poorly wired organizations, getting one's job done is hard work – it is like swimming upstream – while in organizations with good wiring, doing one's job well is the path of least resistance.

Good wiring helps a company build a culture of continuous improvement and requires strong, visible leadership. However, the focus for improvement ideas must be at the front line. The key is to identify those actions that drive value and then systematically identify, evaluate, implement and lock-in ideas that will improve the ability to deliver value. By managing front line actions in a well "wired" asset, management can be confident that the tonnes and profitability will follow. We will demonstrate this premise with a few examples from the mining and metals industry.

(Underground Mining continued on next page.)

Blast Vibration Control in Barrick Goldstrike Underground Division, *Miguel A. Lamadrid, Senior Engineer, Barrick Goldstrike Mines Inc., Underground Division, Elko, Nevada*

Meikle Mine is a high grade underground gold mine with two main ore bodies, Meikle and Rodeo that utilizing primary and secondary long hole open stoping mining method as well as underhand cut and fill when more selective mining method is needed. The combine production in between Meikle and Rodeo is 4,200 tpd with an average grade of 0.361 oz/ton. with a total production in 2008 of 475,000 ounces.

In the production plan for September 2008, was to mine a high grade stope with the inconvenience of the short distance from the limit of the stope and the main rebuild shop. With the success on the result in this stope, will bring the opportunity to cycle more sopes around the area and bring 30,000 ounces for the end of 2008.

Different Blasting techniques where apply for this blast were the main goal was to reduce vibration levels and change the direction of the shock waves in an opposite direction where the re-build shop was located.

The final results were as predicted; having high frequencies levels on the blast and 97 % recovery from design.

Lake Dorothy Hydroelectric Project, Lake Tap and Tunnel, Juneau, AK, *Jason Morrison, Ben Roberds, Chris Hickey, J.S. Redpath Corporation, Reno, NV*

The Norwegian Lake Tap Method was successfully used to tap into the side of Lake Dorothy 36.5 m (1202) below the lake surface. The lake tap allows water to flow into an access tunnel from the lake lowering the water elevation below its natural outfall. When the lake reaches a predetermined elevation below the outfall, a 1.5 m (603) valve in the tunnel will be shut and discharge from Lake Dorothy will stop temporarily allowing construction of a dam located 2.9 km (1.8 miles) downstream at Bart Lake.

The lake tap and tunnel were one phase of the $64 million Lake Dorothy Hydroelectric Project, owned and operated by Alaska Electric Light & Power Company (AEL&P), a private utility located in Juneau, AK. The Lake Dorothy portal site and tunnel are located approximately 25.7 km (16 miles) southeast of Juneau, AK, in the remote Tongass National Forest at an elevation of 701 m (2,3002) above sea level in the mountains above the Taku Inlet. Thirty degree snow covered mountainsides and limited access by helicopter were just two of the many factors which challenged this unique project.

The lake tap and tunnel development consisted of 250 m (8202) of horizontal tunnel, averaging 3.6 m x 3.6 m (122 x 122), excavated using conventional drill and blast methods in highly competent Granodiorite and Tonalite rock, placement of one 3.9 m (132) long concrete plug, or bulkhead, located at the tunnel midpoint, and one 3 m (102) diameter lake tap into the side of Lake Dorothy.

This paper will provide an analysis of the logistical and engineering challenges involved in the development of one of only a handful of lake taps in North America. AEL&P and contractor J. S. Redpath Corporation worked together to complete this critical project phase safely and on schedule, in a location accessible only by helicopter and plagued by constantly changing, harsh weather conditions. A strict schedule had to be maintained to ensure the timely operation of the downstream dam and power plant.

URANIUM

Chair: George M. L. Robinson, *Principal, R Squared, Inc., Centennial, CO*

Permitting the Nichols Ranch ISR Project - What it takes to start a new ISR facility in Wyoming, *Mike Thomas, EHS,Uranerz Energy Corporation, Casper, WY*

What does it take for a junior uranium company to license a new in situ recovery (ISR) uranium operation in the state of Wyoming? For the past two years, this has been the question and the process that one junior has been working on in order to become one of the newest uranium producers in the United States. Uranerz Energy Corporation began the licensing and permitting process in 2006 for their Nichols Ranch ISR Project. After a year of collecting baseline information, Uranerz submitted permit applications for the Nichols Ranch ISR Project in December of 2007 to the Nuclear Regulatory Commission (NRC) and the Wyoming Department of Environmental Quality (WDEQ). Uranerz Energy Corporation was one of the first three companies in over two decades to submit permit applications to the NRC and the WDEQ for a new ISR operation. Currently, the Nichols Ranch ISR Project application has been accepted by the NRC for a detailed technical and environmental review, and the application has been deem "complete" by the WDEQ also allowing further detailed review. Commencement of operations at the Nichols Ranch ISR Project is currently projected for late 2010 or sometime in 2011 depending on the timing of regulatory approval.

Addressing the Public and Regulatory Challenges of Uranium In-Situ Recovery Projects in the United States, *Wayne W. Heili, Vice President of Mining and Engineering, Ur-Energy, Casper, WY*

U.S. based In-Situ Uranium Recovery Operations are well-positioned to generate an increasing share of the global uranium production. While the mining technique is widely regarded as the most environmentally benign method of producing uranium, the industry is under increasing public and regulatory scrutiny for its potential impacts to the local groundwater quality and the environment. This presentation addresses the prominent issues by presenting a review of the consensus science supporting the recovery method and by looking at lessons learned along the way.

Groundwater Restoration at Uranium In-Situ Recovery Mines, *Susan M. Hall, Geologist, U.S. Geological Survey, Central Energy Resources Science Center, Denver, CO*

In-situ recovery (ISR) of uranium causes less surface disturbance than either open pit or underground mines. Although the surface effects of ISR mines are small, the long term impact of this mining method on groundwater is poorly understood. To better establish the effect of ISR mining on groundwater, the U.S. Geological Survey has evaluated the effectiveness of past groundwater restoration techniques used in ISR mines, including pump and treat methods, chemical reduction, and bioremediation.

Traditional pump and treat technologies include groundwater sweep and the use of reverse osmosis, ion exchange, and electrodialysis to restore groundwater. The effectiveness of these methods can be measured by examination of restoration results in Texas ISR well fields in which groundwater has been restored using only pump and treat methods. Before ISR mining, baseline studies show the majority of groundwaters in Texas ISR well fields contain Ra, U, As, Pb, Cd, Se, Hg, Cl, Mn, Fe, SO_4 and total dissolved solids (TDS) at concentrations elevated above drinking water standards as set by the U.S. Environmental Protection Agency. After mining and restoration using pump and treat techniques, the majority of well fields for

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which final sample analyses are available show decreases in Ra As, Pb, Cd, Hg, Cl, Mn, Fe, TDS, F and NO_3, and increases in U, Se and SO_4.

Chemical reduction has been used to remediate groundwater at some ISR well fields in the U.S. H_2S, Na_2S, and H_2 have been injected into well fields to reverse the effects of the oxidizing lixiviant solutions used to mine uranium. Chemical reduction has produced mixed results, but operators continue to investigate this technology.

Bioremediation of groundwater is being actively pursued in at least two ISR well fields in the U.S. Acetate, methanol, cheese whey, molasses, and emulsified oil have been injected into groundwater in well fields to stimulate native bacteria. As bacteria populations increase in response to increased food, metal concentrations decrease in groundwater. Restoration results vary for different elements, and at some sites reduction in analyte concentration in groundwater has been temporary.

The long-term stability of groundwater after remediation has not been well documented. Because Texas regulators require wells be plugged 120 days after restoration, the long term temporal variation in analyte concentration after closure is unknown. Some well fields that have been monitored for longer periods in Colorado, New Mexico, and Wyoming show increasing analyte concentration with time. The process of natural attenuation, the natural adsorptive capacity of ISR host rock to return groundwater to pre mining conditions, has been investigated at some ISR sites outside the U.S. Because it is difficult to return groundwater to baseline following ISR mining, determining the efficacy of natural attenuation at U.S. ISR sites is critical.

Drilling Engineering Concepts and Tools for Uranium ISR Well Design and Construction,
Matt Hartmann P.G., Hydrogeologist, SRK Consulting (US) Inc., Fort Collins, CO

A uranium in-situ recovery (ISR) well field represents a significant capital investment in the development of a resource. Proper understanding of well design, drilling procedures, construction methodology, drilling management, and quality assurance/control are all required to produce efficient and economically sound well fields.

Uranium ISR wells are designed to meet regulatory and technical requirements at the lowest possible cost. The design and materials have been relatively unchanged over the past 30 years. In general, the only variability in well design from one project to the next is the preparation and completion of the screen interval. Proper understanding of the ore bearing formation hydraulic properties, well hydraulics, drilling fluid program, and well development are all required to select the completion type that does not inhibit well performance while presenting the lowest economic impact. In addition, because well designs are not changing, technical advancement and optimization should be focused on driller training, field techniques, and management of the drilling operations.

Ideas, concepts, and practical tools will be presented that can be applied to the well field drilling and construction process to address problematic routines prior to mobilization and during active operations, streamline drilling operations for cost and time savings, and increase overall well field performance and durability.

(Uranium continued on next page.)

Exploration and Discovery of Blind Breccia Pipes and the Potential Significance to the Uranium Endowment of the Arizona Strip District, Northern Arizona, *Eugene D. Spiering, VP Exploration, Patrick D. Hillard, and Joseph R. Inman, Quaterra Resources Inc., Vancouver, BC, CANADA*

In April of 2008, Quaterra Resources announced the discovery of uranium mineralization in a blind breccia pipe on the A-1 geophysical target. Hole A-01-31 intercepted a thickness of 57 feet averaging 0.33% U_3O_8 in mineralized collapse breccia at a depth of 1,034 feet. The A-1 pipe structure has no vertical collapse within 400 feet of the surface. The discovery resulted from holes testing the first of more than 200 anomalies identified by an airborne time domain electro-magnetic (VTEM) geophysical survey. Two months later, the first hole targeting A-20, the second VTEM anomaly to be tested, discovered another mineralized breccia pipe. The A-1 discovery and the geophysical technology used to identify it could have a significant impact on the production potential of the district.

Most breccia pipes with structures visible at the surface in northern Arizona have been found by past exploration. The total amount of mineable uranium discovered to date is estimated to be in the range of 40 million pounds eU_3O_8. Approximately one sixth of this total (7 million pounds) was mined from Hack 2; a single blind pipe discovered by tracing alteration in the Coconino Sandstone near the Hermit Shale contact along the walls of Hack Canyon by Western Nuclear in 1979.

Hack 2 represented the only blind pipe ever found in the Arizona Strip until Quaterra's discovery of the A-1 pipe. However, blind pipes may be the most numerous type of mineralized structures in the district. The USGS Open File Report (OFR-89-550) shows the mapped locations of 1,296 pipes in northwestern Arizona. Carboniferous strata exposed in the deeper canyons of the region have the highest density of pipes with approximately 3 pipes per 10 square miles. The number of outcropping pipes decreases dramatically below the cover of successive layers of Permian sediments until fewer than 2 pipes are evident over an area of 500 square miles in the lower Triassic rocks. The upper level of stoping by collapse varies and many pipes occur at depth with no surface evidence of a pipe throat. If these structures penetrate the Coconino Sandstone in a favorable area of the district, a blind orebody can exist with no pipe structure at the surface. The number of pipes identified to date could represent only a small fraction of the total number of mineralized blind pipes that lie waiting to be discovered at depth.

A 1987 USGS study (Circular 1051) calculated a mean endowment of 112.4 tons eU3O8 per square mile for the Arizona Strip district. The 1,670 square miles of public lands remaining open to uranium exploration in the district has an estimated total mean endowment of 187,690 tons (375 million pounds) eU3O8 representing a potential energy equivalence of 13 billion barrels of oil. With modern airborne and down-hole time domain EM geophysical surveys applied to the search for blind breccia pipe orebodies, the Arizona Strip may one day become one of the most important uranium and energy producing districts in the US.

Lunch and Drink Tickets
are available at NWMA Registration.

STRATEGIES FOR OPTIMIZING MINE WASTE MANAGEMENT

Chairs: **Eur.Geol, Robert Bowell, Ph.D., C.Chem C.Geol**., *Principal Geochemist, SRK Consulting, Cardiff, Wales, UK*
Lisa Bithell Kirk, M.S., P.G., Doctoral Candidate, *Principal Geochemist, Enviromin, Inc., Bozeman, MT*

Pond Reclamation at U.S. Borax, *Richard Peevers, Project Engineer, Vector Engineering Inc., Grass Valley, CA and Sheri Williamson, Environmental Engineer, Rio Tinto Minerals Boron Operations, Boron, CA*

Mine waste comes in many forms and must be managed in both an environmentally and economically sound fashion. The unique qualities of some of the solid waste at a large open pit mine in California allow for both of these criteria to be met.

One of the largest borate deposits in the world is man-made, and exists in the evaporation ponds at U.S. Borax. This mine has been operating since the early 1900s, and over that time processing techniques have improved. Material considered as "gangue", or waste, 20 years ago is now economical to reprocess. Reprocessing the material in the ponds allows the mine to reduce costs by reducing the stripping ratio, and it allows the mine to clean up and reuse pond space currently designated for Group A mining waste. The reprocessing will reclaim material with economical borate grades. The remaining material is non-acidic and has low TCLP values for arsenic, which means it can be designated as Group C mine waste.

This paper discusses some of the details of the Report of Waste Discharge recently submitted to the Lahontan Regional Water Quality Control Board.

Reducing Cost and Impact through Use of Alternative Feed Stock Materials at Northwest Mine Sites, *Nicole Prokop, Environmental Engineer and Sales & Marketing Manager, Evergreen Recycling, Inc., Morgan, Utah and David Lahaie, Marine Engineer and President, Evergreen Recycling, Inc., Seattle, WA*

The U.S. is in a time of "greening", where businesses, governments, and individuals are working to improve management of water conservation, waste reduction, and their overall impact on the environment. The words c*arbon footprint, fuel efficient* and *recycling* are even making it into our dinner table conversations! Recycling programs are growing across the nation. While recycling cardboard and aluminum cans are what most people think of when they think of recycling, for mining companies it's those obscure, industrial byproducts that offer the greatest improvement in environmental and economic efficiency.

Two case studies illustrating efforts of mining/manufacturing operations in the Northwest to identify alternative raw material feed stocks that supplement and offset their appetite for mined, non-renewable materials will be presented. These examples demonstrate how these operations have been able to conserve their own mined materials, extend the life of mining reserves, and realize positive cash benefits to their bottom line.

Microbial Ecology in Operational Mine Waste Management, *Lisa Bithell Kirk, M.S., P.G., Doctoral Candidate, Brent Peyton, PhD, Chemical and Biological Engineer, Center for Biofilm Engineering, Montana State University, Bozeman MT, and Randy Hiebert, M.S. P.E., MSE Technology Applications, Inc., Butte, MT*

Recent advances in microbial geochemistry have identified new possibilities for operational mine waste management. Consideration and integration of microbial processes into mine site design and waste management offers significant potential for reduced cost and impact association with mining operations. Efforts to incorporate conversion of mobile and toxic

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selenate to insoluble and non-toxic elemental selenium by native microbes into the design of phosphate mine facilities through manipulation of key ecological variables including lithology, moisture content, and oxygen will be discussed. Subsurface biofilm barriers, in the form of horizontal caps to prevent oxidation of mine tailings and waste rock or vertical barriers to manipulate groundwater movement and remediate contaminants, will also be presented. Such operational ecology strategies have significant potential for source control in a variety of mining environments.

Assessment of Value Recovery From Mine Waters, *Bowell, R.J.[1], Dey, M.[1], Williams, K.P.[2], Sapsford, D.J.[1], Barnes, A.[1], Grogan, J.[1] and Thomas, D.[2]*
1 SRK Consulting (UK) Ltd, Cardiff, CF10 2HH, UK
2 Cardiff School of Engineering, Cardiff University, Cardiff, CF24 3AA, UK

The closure and abandonment of mining areas is rarely due to complete consumption of a mineral resource but rather diminishing financial returns based on metal values, or social, political and environmental restrictions that lead to an uneconomic scenario for a resource unit.

One form of value recovery from mine waters is the precipitation of metals or rare salts as a product of water treatment. Several operations are active globally and many sites have been evaluated for potential to apply methods of metal recovery. The successful development of these resources and value recovery often requires more efficient metallurgical circuits or new chemical and physical extraction procedures to recover value. Traditional and more innovated methods have been assessed in the recovery of metals and salts from mine waste and mine waters and are reported here.

Additional Key Words: mine water chemistry, recycling, reprocessing

DISCOVERING CHINA AND MONGOLIA: EXPLORATION TO MINING

Chair: Dr. Dean McDonald, *Vice President Exploration, Hecla Mining Company, Vancouver, BC, CANADA*

Heruga – the most recent Discovery on the Oyu Tolgoi Trend, Mongolia, *Lindsay Bottomer, Vice President Corporate Development, and Robert Cann, Vice President Exploration, Entrée Gold Inc., Vancouver, BC, CANADA*

The Heruga porphyry Cu-Au-Mo deposit in the South Gobi Region of Mongolia was discovered in early 2007 by drilling of an IP chargeability anomaly. Drilling to early 2008 has outlined an inferred mineral resource estimated at 760 million tonnes grading 0.48% Cu, 0.55 g/t Au and 142 ppm Mo for a copper equivalent grade of 0.91%, using a 0.60% copper equivalent cut off grade. Subsequent drilling has intersected additional mineralization, and an updated resource is pending.

Heruga represents the southernmost deposit currently known on the 20+ km long Oyu Tolgoi Trend. The discovery was located on ground owned 100% by Entrée Gold Inc., under option to Ivanhoe Mines Ltd. Ivanhoe has subsequently earned an 80% interest in the exploration concession containing the Heruga discovery.

The porphyry-style mineralization is developed at depths between 500 and 1400 or more metres below surface, hence the deposit was a “blind” discovery. Encouragement to drill test

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such a deep target was provided by (1) the location of the Heruga IP anomaly along the projected southern extension of the Oyu Tolgoi structural trend, (2) the occurrence of anomalous copper values and occasional gold spikes in soil sample lines near the northern boundary of the Entrée property crossing the projected continuation of the Oyu Tolgoi Trend, and (3) the successful delineation of high grade Cu-Au mineralization along trend at Hugo North at similar or greater depths from drilling of IP targets.

The first hole (EJD-001) intersected 214 metres grading 0.25% Cu, 0.12 g/t Au and 64 ppm Mo. Subsequent drilling rapidly defined a major new deposit with many similarities to, but also significant differences from, the deposits along trend to the north. Similarities include the Late Devonian age of the mineralization and associated quartz monzodiorite intrusive rocks, emplacement into basaltic host rocks of presumed earlier Devonian age, and location along a major N20E oriented structural trend. Differences include a much higher gold content relative to copper, presence of significant molybdenum, and predominantly volcanic host rocks.

The deposit exhibits typical porphyry-style silicate alteration, with strong potassic alteration in the core generally surrounded by quartz-sericite alteration. In contrast to Hugo North, only minor advanced argillic alteration is present. The metallic mineralization is strongly zoned with a molybdenum-rich copper (+/- gold) shell overlying a gold-rich copper zone. The transition between the two styles of mineralization is often abrupt over a few metres. This zoning has not been observed in the deposits along trend to the north, and is the opposite of typical zoning trends in most Cu-Au+/-Mo deposits. Quartz-chalcopyrite stockwork veining is the main form of copper mineralization, although disseminated chalcopyrite and minor bornite also occur.

The Heruga deposit is still at an early stage of exploration but already it rates in the top tier of Cu-Au porphyry deposits worldwide in terms of size and contained metal. Potential to increase the resource is considered to be excellent – a recent announcement by Ivanhoe Mines confirms that mineralization is present along trend to the north on their 100% owned ground. To the south, mineralization is truncated against an E-W fault, with inferred displacement of several kilometres to the west. This target remains untested. Further exploration along the Oyu Tolgoi Trend will undoubtedly add to the currently known resources in what is now one of the world's great copper-gold districts.

The recent signing of an Investment Agreement between the Government of Mongolia, Ivanhoe Mines and Rio Tinto paves the way for development of the Oyu Tolgoi deposits, including Heruga. Conceptual mining scenarios will be briefly discussed.

POWER SESSION DEUX -
STRATEGIC ENERGY MANAGEMENT CASE STUDIES

Chairs: **Ann S. Carpenter**, *President & CEO, Remote Energy Solutions, Reno, NV*
Luke J. Russell, *Vice President Environmental Services, Coeur d'Alene Mines Corporation, Coeur d'Alene, ID*

Renewable Energy and New Energy Deployments, *Ann Carpenter, President & CEO, Remote Energy Solutions, Reno, NV*

Co-use of sites, facilities, buildings - examples of energy renewable energy and new innovations from around the world.

Compressed Air and Pumping Systems - Major Energy Reductions, *Tony Teske, Credentialed Energy Manager, Consultant, Lancaster, CA*

Case studies will be presented on these two topics, leading to energy reductions and significant cost savings.

Lisheen Wind Farm - Alternative Energy and Mining,, *John Elmes & Geoffrey Beale, Principal, Schlumberger Water Services, Water Management Consultants, Inc., Reno, NV*

Alternative energy and mining - ways to evolve mine sites; co-use and new industries.

Energy and Carbon Management, *Dr. Charles Reith, Professor of Environmental Science & Policy, George Mason University, Principal, Remote Energy Solutions, Reno, NV*

Large gold heap leach facility -- energy and carbon management assessment and associated identified energy savings and carbon-GHG reductions will be summarized, along with new innovative technologies discussed.

Sustainable Energy Savings - A Study in Environmental Leadership at a Canadian Mining Company, *Jon Feldman, CEM, Managing Consultant, Energy Management, Hatch Management Consulting, Oakville, ON, CANADA*

Energy Management, and in particular the sustainability of energy reductions, is becoming an increasingly important issue for large industrial companies. The "green economy", is placing pressure on corporations to become more active at the corporate level in reducing energy use and greenhouse gas emissions.

What is required is a structured framework within which the company can change the processes and work habits that will lead to sustainable reductions in energy use and energy intensity. This process is not about a silver bullet that is going to save the company 5%, or 15% of their energy bill in the next year. It is about a systematic process that fundamentally changes the way the entire organization views and manages energy. Until energy management becomes part of the way a company does business, at best, savings will be short lived.

This presentation will use a leading Canadian Mining company to illustrate what can be achieved through establishing an effective energy management program that is driven from the executive level.

NWMA's Traditional 'Moose Milk' Will Be Served
During the Friday Morning Coffee Break -
Be There!

HEALTH AND SAFETY - CULTURE OF PREVENTION

Chair: Fred Fox, *Manager, The Trapper Consulting, LLC, Salt Lake City, UT*

Mine Safety & Health – Getting Ahead of the Political Curve, *Bruce Watzman, Sr. Vice President Regulatory Affairs, National Mining Association, Washington, DC*

Most mine safety professionals believe that a new mind-set, outside the bounds of legal and regulatory constraints, is required if continued improvement in mine safety performance is to be achieved. To assist in advancing industry performance, the National Mining Association has kicked- off a new program to further enhance mine safety and health. The program, built on the pillars of communication, collaboration and training serves as the instrument for the sharing of best practices across all industry participants. This effort and a record safety performance in 2008 contrast with a political landscape that suggests new challenges lay ahead.

Legislative, Regulatory, and Case Law Update, *Timothy R. Olson, P.C., Attorney at Law, Brighton, CO*

The presentation will address a number of topical issues in mine safety and health law, including: (1) pending and/or anticipated mine safety and health legislative initiatives; (2) MSHA's regulatory agenda; (3) important new MSHA policy statements; and (4) recent court decisions concerning mine safety and health law.

Rio Tinto – A Global Approach to Safety, *Patrick James, CSP, Principal Advisor Safety, Rio Tinto, South Jordan, UT*

This presentation provides an overview of Rio Tinto's approach to establishing world class safety performance globally. The discussion will review the various components of the organizations safety processes and how the model is applied globally as well as regionally in North America and the United States. In a recent report, the US Mine Safety & Health Administration (MSHA) ranked Rio Tinto first in the top 25 metal and non metal mining companies for 2008 based on the safety performance of its US based businesses.

The discussion also includes a general summary of the Rio Tinto model including management systems, risk based approach, safety performance standards, lagging and leading indicators, verification and auditing process, contractor management and sustainable safety culture. The presentation is designed to be an interactive discussion.

New Mine Development – Health and Safety Priorities, *Jon Cherry, PE, General Manager, Kennecott Eagle Minerals Company, Ishpeming, MI*

Development of a new greenfield mine presents many opportunities and challenges regarding the health and safety of the workforce. There are many opportunities to create a new culture and break bad habits while developing a future long term workforce. There are also many challenges associated with a transitional work force and the compressed time period that is available teach and train the workforce. Using the Kennecott Eagle Nickel Project as a case study, this presentation will focus on some of the high level health and safety priorities associated with developing a new mining project and creating the long term desired safety culture from the beginning.

(Health & Safety continued on next page.)

The Human and Ecological Risk Assessment Process as a Decision-Making Tool for Mining Sites, *Anne Thatcher, Certified Principal in Charge and Margaret Bartee, ARCADIS, USA, Alexandra Belaunde and May-Lin Almendras, ARCADIS, Chile*

The presentation will present results from a site-specific study which incorporated risk assessment as a tool to support cost-efficient management, control and/or corrective measures for potential future risks under a post-closure scenario. The study focused on the risks to human health and ecosystem around a CODELCO Salvador Division mining site, in northern Chile, which uses two production lines, oxides and sulfides, for copper extraction. Fourteen (14) areas were identified based on a review of available data and site visits, and associated areas of influence were mapped according to results from field samples collected during the course of the study. A risk assessment was carried out for each area, focused on the conceptual site model (i.e., source-route-receptor study) on a site-specific scale. Information from three concurrent studies was incorporated into this study: (i) the analysis and mapping of potentially contaminated soil, (ii) a hydrogeological survey and monitoring of water resources and (iii) an acid drainage study as well as a dispersion model associated with a large tailings impoundment.

The resulting risk values allowed consistent, verifiable and auditable conclusions to be reached as regards which areas of influence, from the human health and ecological point of view, may require control or risk management measures to be put in place. Considering the sampling data associated with the soil, air and surface water, the risk values are representative of possible future exposure (oral, dermal and inhalation). There were a few areas recommended for additional control measures due elevated concentrations of metals and low pH in surface water.

ENVIRONMENTAL LAW AND MINING IN THE OBAMA ERA

Chairs: **Fred R. Wagner**, *Principal, Beveridge & Diamond, PC, Washington, DC*
Peter J. Schaumberg, *Of Counsel, Beveridge & Diamond, PC, Washington, DC*

Will the Obama Administration Threaten Mining by its Endangered Species Act Policy and Regulatory Decisions?, *Charlotte L. Neitzel, Partner, Holme Roberts & Owen LLP, Denver, CO*

The Obama Administration has systematically reviewed many decisions made during the Bush Administration on Endangered Species Act ("ESA") policy and regulations. Some of the decisions have remained intact after the review, such as the decision that an environmental group failed to provide convincing evidence to list 165 species as endangered, and the decision to retain the listing of the polar bear as a threatened species. Other decisions have been withdrawn. The Department of Interior and Department of Commerce under the Obama Administration withdrew the section 7 consultation rulemaking promulgated in the waning days of the Bush Administration that provided federal agencies more flexibility in deciding whether to consult with the Fish and Wildlife Service and the National Marine Fisheries Service if certain requirements were satisfied.

While some believe that the Obama Administration may expand review of covered actions under the ESA, it is too soon to predict this Administration's stance. For example, the

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ENVIRONMENTAL LAW AND MINING ... *(Continued)*
Will the Obama Administration Threaten Mining... (Continued)

withdrawal in the Federal Register of the section 7 consultation rulemaking also invited comments regarding potential changes to these regulations, and the agencies plan a "comprehensive review" of the regulations. We will discuss the status of this review and possible impacts on permitting mining projects. Another uncertainty is the role of the ESA in reducing greenhouse gas emissions. We will discuss the status of Interior's position regarding whether the ESA can be used as a vehicle to reduce greenhouse gases. We will also cover other significant developments under the ESA as of the date of the conference.

TRADITIONAL LARGE LEFT LATERAL LEAPS

Chairs: **Ann Carpenter**, *President & CEO, Remote Energy Solutions, Reno, NV*
Harry E. Cook, *Consultant, Carbonite Geology LLC, Redwood City, CA*

From the Kaibab Plateau to the High Lava Plains: Where is the Carlin Trend?, *Kelly Cluer, Director, Altan Rio Ltd., Carson, City, NV*

The presentation will examine what and where the Carlin Trend has been in history, how it has evolved in the collective minds of geologists working it, how its mystique and ambiguity have been used for various purposes. The focus will draw on geological and geophysical observations that help to bring definition to this feature of extraordinary gold endowment and production, and recipient of immense exploration spending during its 50 year "trend" history. Coupling a new broad-scale definition of the Carlin Trend with innovation in exploration philosophy and technology will open up enormous exploration frontiers in Nevada.

Structure of the Pipeline-Gold Acres Window, *Tomas Chapin, Geologist, Barrick Gold Corporation, Reno, NV*

Demonstrates 1000' thick destruction zone including 80 feet of mylonite; along with some more conventional thrust architecture that is frequently alluded to in the literature as a contrast in thinking. Many models completely ignore this type of destruction when they create duplexes.

Oil Field Brines, Organic Acids and Carlin-style Mineralization: A parallel verse in the ever expanding Carlin Multiverse, *Jim Essman, Project Geologist, Newmont Mining Corp., Carlin, NV*

The paper will examine the similarities between oil field brines, basinal brines and what we think we know about Carlin mineralizing fluids based on the deposit characteristics. I will also explore the plausability that Au and other Carlin pathfinders might have been leached from enriched sediments in the deep, dark and ugly by organic acids created during post depositional diagenesis, and subsequently transported to their site of deposition via tectonic forcings.

Burgess II: It Really Was Good Eating, *Stan Keith, President, MagmaChem Exploration, Inc., Conoita, AZ*

Description: In this re-take of the Burgess Shale talk given in December 2003, a plethora of new data is presented that shows that the Burgess critters existed in the context of mud volcanism and mineralized fluids at the top of a giant MVT-style lead-zinc-bearing hydrothermal dolomite system of probable middle-Cambrian age. Major implications of the new data for Cambrian orogonenic events, the Cambrian life explosion, and the extinction events will also be discussed. My co-authors on this will be Kimberley and Paul Johnston of Calgary, Canada.

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Origin of Carlin-type Gold Deposits, *John Muntean, Research Geologist, Nevada Bureau of Mines and Geology, Reno, NV*

A case is made that Carlin-type gold deposits in Nevada represent the convergence of non-unique magmatic-hydrothermal processes with an ideal architecture that appears to be specific to Nevada.

METALLURGY

Chair: Dr. Corby G. Anderson, *CEng FIChemE, Harrison Western Professor of Metallurgical & Materials Engineering, Colorado School of Mines, Golden, CO*

Hydrometallurgical Treatment of Gold Bearing Copper Enargite Concentrates, *Dr. Corby Anderson, Colorado School of Mines, Golden, CO and Larry Twidwell, Montana Tech, Butte, MT*

This paper outlines the application of industrially proven technologies of low pressure and low temperature Nitrogen Species Catalyzed (NSC) pressure leaching and Alkaline Sulfide Leaching (ASL) for the recovery of copper and gold from enargite. Copper can be recovered as a cathode metal or as a clean concentrate suitable for smelting. Gold is recovered by smelting, conventional cyanidation, or via alkaline sulfide hydrometallurgy. Coupled with this is the effective precipitation and stabilization of arsenic as scorodite and ferrihydrite.

Mineral Liberation Analysis of PGM's in Stillwater Mining Company's East Boulder Mill Circuit, *Paul Miranda, PhD., Process Engineer, CAMP - Montana Tech, Butte, MT*

This paper will outline the concepts and the application of Mineral Liberation Analysis to optimize the Stillwater East Boulder Mill Circuit. Issues addressed and successful industrial outcomes will be elucidated.

Critical Metals Recycling, Research and Development at the Colorado School of Mines Kroll Institute for Extractive Metallurgy, *C. Anderson, P.Taylor and J. Hohn, Kroll Institute for Extractive Metallurgy, Colorado School of Mines, Golden, CO.*

This paper will outline the capabilities for and applications of critical metals research and development at the Kroll Institute for Extractive Metallurgy (KIEM) and the Center for Resource Recovery & Recycling (CR3) located at the Colorado School of Mines. Recent case studies on electronic scrap recycle and industrial gold ore processing will be highlighted.

Fundamental Procedures To Evaluate and Design Industrial Waste Water Treatment Systems, Case Study Discussions, *Jay McCloskey[1], Larry Twidwell[2], Brian Park[3]*

[1]Center for Advanced Mineral and Metallurgical Processing

[2]Montana Tech of The University of Montana, Butte, MT

[3]MSE-Technology Applications, Mansfield Technology Way, Butte, MT

Methods and techniques to evaluate, design, and implement innovative hydrometallurgical waste water systems for the reduction of dissolved arsenic, selenium, and other constituents from industrial waste waters. Cast studies of projects will be presented summarizing the fundamental progression from the laboratory-scale, pilot-scale, and implementation at full-scale. Design issues and operation of the innovative approach to reduce arsenic and selenium

(Metallurgy continued on next page.)

from the industrial waste waters are presented and discuss.

The Development And Implementation of Industrial Hydrometallurgical Gallium and Germanium Recovery, *Todd Fayram, Continental Metallurgical Services and Corby Anderson, Colorado School of Mines.*

The Gordonsville Operation of Pasminco US Inc. developed and implemented a pilot scale hydrometallurgical facility for the industrial recovery or germanium and gallium. This paper describes the joint testing and engineering program that culminated in this successful process. Pertinent capital and operating costs will be presented along with the resultant industrial flowsheet.

ALTERNATIVE USES FOR CLOSED MINE SITES CASE STUDIES

Chair: **Tom Crosby,** *Principal Engineering Geologist, Stantec Consulting Services, Inc., Lafayette, CA*

Motocross Meets Miner-The Economic and Environmental Benefits of Changing Mine Reclamation in Real Time from Native Habitat Restoration to a Motocross Park on the Pala Indian Reservation, California *Douglas W. Sprague, Manager of Reclamation, Vulcan Materials Company-Western Division, Los Angeles, CA*

Sand and gravel mining at Vulcan Materials Company's Pala site had been ongoing since the 1960s. Reclamation of the mine was begun by Vulcan in 1999. It was interrupted in 2006, at the request of the Pala Band, to provide for an off road vehicle park. At that time about 106 acres have been reclaimed to native habitat in addition to channel improvements made to Magee Creek. This work was pursuant to a concept Reclamation Plan approved by the Band and BIA in 1999 and finalized in 2004. By 2006 the un-reclaimed pit floor, was slated to be restored to native habitat under the existing Plan. Instead, under a revised Plan, it became a Motocross Park. Grading of the pit floor to accommodate the Park was completed and the mine site closed in late 2008. The Park, run by Pala Raceway, opened shortly thereafter, in early 2009.

The Motocross Park complemented the Pala Band's Casino, Hotel and world class Skateboard Park in northern San Diego County. Construction of the Park avoided impacts to sensitive species by utilizing the un-reclaimed pit floor. Purchase of mitigation property required as an off set for such impacts would have made the Park uneconomic. Not having to revegetate the pit floor was a cost savings to Vulcan. Rough grading of the site by Vulcan and the utilities left from its mining operation were cost savings to the Park operator. Having a close in (to urban areas) alternative to off-roading in sensitive habitats, like the adjacent San Luis Rey River, or to traveling to more distant recreational areas benefited the environment.

(Alternative Uses for Close Mine Sites continued on next page.)

City of Irwindale, Mining to Prosperity, *J. C. Isham, Geology Manager, Shaw Group, Concord, CA*

The City of Irwindale is 9.5 square miles in size, located in the populated suburbs 20 miles east of downtown Los Angeles, the second largest metropolis in the nation. Over 50% of the usable land in the City is home to sand and gravel quarries operated by some of the largest aggregate mining companies in the nation. Much of the infrastructure of Los Angeles in the past 50 years was built from the aggregate mined from Irwindale.

The large open pits, once thought as an eye sore, are now some of Irwindale's riches access. Irwindale has looked to the future and with the partnership of the many mining companies has developed a unique reclamation plan to use many of these pits as the location of business parks, sports arenas, and industrial areas. Some of the most unique uses include the following:

- The $125 million Irwindale Business Center is a 2.2 million square foot light industrial development on a 130-acre site that was previously a sand and gravel quarry. It is truly a "poster child" for reclamation in an urban area and is now home to 18 buildings that house 35 new companies and 2,200 employees. The assessed value prior to this project was $3 million dollars for basically a spent pit. Today, the assessed value is over $63 million dollars.
- One of the largest waste management companies has occupied one of the quarries and is now backfill the pit with demolition debris. This site is also a recycling center for concrete demolition debris. Ironically, some of the aggregate that was mined from Irwindale is now returning to the city to reclaim its land for new uses.
- A world class NASCAR race track, the Toyota Speedway is located in one of the old pits. This race track, which opened in 1999, features banked 1/2 and 1/3 mile oval tracks and a drag strip.

For mine sites located in an urban area, the development potential for Irwindale is limitless. Two of Los Angeles' major freeways pass through Irwindale, accounting for a traffic count in excess of 400,000 vehicles per day. Developments within these population centers can provide financial windfalls to spent mine sites. Prior to reclamation, these open pits had assessed values of 5% of the post reclamation value. Other positive impacts include improved environmental conditions and visual aesthetics. Some times making a big hole in the ground can be a good thing.

The RiverPark Project - A Case Study in Urban Reclamation, *John Hecht, P.E., President, Sespe Consulting, Inc., Ventura, CA*

Since 1950, Hanson Aggregates West, Inc. ("Hanson" - formerly S.P. Milling) has operated a 400+ acre sand and gravel mining operation located adjacent to the Santa Clara River in Ventura County, approximately one mile from the Pacific Ocean. With aggregate reserves depleted, the site was scheduled for reclamation. During the 50 years the mine operated, the neighboring coastal communities had grown, causing the operator to re-evaluate the original reclamation plan end land use designation of "Open Space". As a result, Hanson teamed with RiverPark B Development LLC ("RiverPark") to develop a mixed-use community of residential and commercial land uses, public facilities and open space that provides for complete reclamation of the mined areas. Previously mined and refilled areas will be re-

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excavated and re-compacted, and mining pits with open water will be utilized by the United Water Conservation District to enhance and preserve local groundwater supplies. The presentation will describe the process of urban redevelopment reclamation planning, compliance with the California Surface Mining and Reclamation Act of 1975, the creation of a new agency responsible for reclamation, and success and challenges encountered in the implementation of this $20M+ project.

Presentation Summary:

1. **Introduction and Presentation Outline**
2. **RiverPark Project**
   a. **Idea.**
   The genesis of the RiverPark project will be explained and the overall scope and pieces of the project will be described.
   b. **Partners.**
   Any project of this magnitude requires a series of teams, from those that get it started to those that make it happen. Each team must be successful for the project to be completed.
   c. **Plan.**
   The RiverPark project is best described by the specific plan for development that has been approved by the City of Oxnard.
   d. **Process.**
   The entitlement process with times required will be reviewed. Many agencies had input into the project design and required mitigation or special handling. The entitlement process and colorful challenges will be discussed
   e. **Results.**
   Where is the project now and what contributed to the results?
3. **Reclamation Issues**
   a. **Pit Reclamation – Technical Issues.**
   Geotechnical issues were the greatest challenge in developing the new RiverPark reclamation plan. The Geotechnical Consultant, Fugro West, researched the history of the mining and regenerated topography from historical aerial photos. A video rendering will be presented that graphically shows how the site was excavated. Establishing geotechnical standards for slope stability was of key importance in both the environmental review and in assuring that the end use could be achieved.
   Various stabilization methods including dredging and deep dynamic compaction were considered in the range of available alternatives. Recent reductions in pit water levels may make traditional stabilization methods practical.
   b. **Plant Site Reclamation – Technical Issues.**
   Because they are at grade and adjacent to RiverPark A, the plant and stockpile areas were targeted for reclamation to development standards. This primarily consists of over excavation and re-compaction, but in certain areas includes deep excavation combined with de-watering.
   c. **Reclamation Entitlement Process**
   i. Development of a new Surface Mining Ordinance
   ii. Financial Assurance update, increase from approximately $9 Million to over

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$16 Million

iii. CEQA and Public Hearings. The EIR was completed and certified when the RiverPark project was approved, the Reclamation Plan and Financial Assurances were approved in a separate hearing at the City of Oxnard Planning Commission.

d. Surface Water Quality Issues.

Runoff from adjacent industrial and agricultural areas has historically entered the pits. Extensive technical analysis and modeling of the groundwater in the area was required to complete the CEQA and entitlement process. The resulting drainage plan includes pre treatment swales and the ability to contain a 10 year rain event. Larger rain events will overflow into the pit areas.

e. Reclamation Implementation.

A Joint Powers Authority (JPA) consisting of the City of Oxnard and the United Water Conservation District was created to manage the pit reclamation implementation and to manage grant funding.

4. Implementation Update

Since 2003, the project has been the subject of legal and operational challenges. A partner in development took title and reclamation responsibility, then refused to honor the contract. Litigation ensued that included challenges to the scope and adequacy of the reclamation plan. Litigation was concluded and the land was returned to RiverPark so reclamation could begin.

Onsite grading activities began in 2004, and the next portion of the presentation will discuss some of the onsite challenges that the project has faced.

The Project includes reclamation of three aggregate mining pits containing exposed groundwater. The reclamation plan included various remediation techniques for stabilization of the pit slopes and was designed using the historic average water level of 45’ above mean sea level (amsl). In summer of 2004, water levels within the pits dropped to below 20’ amsl. Remediation techniques were adjusted accordingly. The 2004/2005 rainy season was the 2nd wettest on record for the Los Angeles area. Water levels rose by over 30’ in a three month period. The impact on reclamation activities was staggering and will be described and illustrated using photographs.

Since much of the site had been mined and backfilled with excess material during 50 years of operations, the reclamation plan and associated geotechnical reports were based on limited data and assumptions. A critical part of the reclamation process was the verification of native/fill interfaces and the removal of fill material. Methods were adjusted as the water level changed, and the presentation will illustrate the results and challenges.

For one of the pit slope areas, we will present a start to finish step by step visual chronology of the reclamation process including placement of Geogrid reinforced material, final slope preparation and hydroseeding.

Reclamation Costs were estimated in 2002 using best available information. As part of the ongoing reclamation process, a side by side comparison of estimated vs. actual costs has been created. A portion of this will be presented to illustrate how

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items can change.

DUSEL, The Development of the Deep Underground Science and Engineering Laboratory at Homestake, *Sydney (Syd) De Vries, Underground Construction Project Manager, Lawrence Berkeley National Lab, Berlekey, CA*

At the Homestake mine in Lead, South Dakota, over 40 million ounces of gold were produced over it's 127 year life. In addition to gold mining, important science experiments were conducted under the leadership of physicist Ray Davis. At the 4850 L, a Laboratory was constructed in 1965 to study mysterious sub atomic particles emitted from the sun called "neutrinos". The conclusions drawn from this experiment earned Ray Davis the Nobel Prize for Physics in 2002.

In 2001, Barrick Gold decided to permanently shut down the Homestake mine. Pumps were shut down in June of 2003 and the mine was permitted to flood. However, interest in the science community in constructing an underground laboratory to conduct physics and geological experiments was growing. In response to this, the National Science Foundation (NSF) initiated a process of solicitation of proposals for the development of a National Deep Underground Science and Engineering Laboratory and the old Homestake mine was considered to be a strong candidate due to its extensive underground workings and access to depths of up to 8,000 ft

In 2006, Barrick Gold donated the mine to the South Dakota Science and Technology Authority (SDSTA) for the purpose of converting the mine into an Underground Science Laboratory. Using funds committed from the state government as well as a private donation from T. Denny Sanford, the SDSTA began the process of re-habilitating the mine in 2007 for the purpose of dewatering the mine and establishing an early science program. In addition, the NSF announced its decision to select the Homestake mine as the preferred location to develop DUSEL.

This presentation will discuss the process of converting the old Homestake Mine into an Underground Science Laboratory. In particular, challenges relating to excavation design, infrastructure rehabilitation and upgrades will be discussed.

IT IS NOT TOO EARLY: THE VALUE OF CORPORATE SOCIAL RESPONSIBILITY (CSR) IN EXPLORATION AND PROJECT DEVELOPMENT

Chair: Caroline Rossignol, *Manager, Corporate Social Responsibility, Barrick Gold Corporation, Vancouver, BC, CANADA*

Effective Aboriginal Engagement = Corporate Social Responsibility, *Dan M. Jepsen, RPF, Chairman and CEO C3 Alliance Corp., Vancouver, BC, CANADA*

Aboriginal community engagement is a necessity in any resource development project. Resource development and industrial projects will be extremely challenged anywhere in the world if local indigenous people and communities do not embrace the project, have deep and unresolved concerns, and become organized and vocal.

Land access and tenure certainty for exploration and mine development is critical to the foundation of a healthy, sustainable, and environmentally sound, mineral exploration and mining sector. Without this certainty, mineral exploration activity will be reduced, or in some cases, completely curtailed.

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The mineral sector faces many challenges in regard to building positive relationships with First Nations. The root solution to addressing these challenges lies in recognizing and understanding the unique cultural differences that exist between indigenous people and the business community. The traditional business approach and relationships that business incorporates with contractors, legal counsel, investors and boards are not the best approach for the introductory and subsequent meetings with indigenous peoples and communities.

Consultation and accommodation are the most challenging and often controversial topics in the realm of successful Aboriginal community engagement. There is no template that defines how much consultation is enough, and if accommodation has been delivered, but there is one clear rule: all parties – the company, all levels of government and First Nations – should benefit.

Reaching a consensus requires keeping an open mind, carefully listening to the community and indigenous peoples and a dedicated and sincere commitment to explore solutions. Companies must be patient, respectful, honest and trustworthy in their discussions, meetings and negotiations with indigenous communities. If you cannot do it, say why; if you can do, do it.

Litigation is too often viewed by the business community as the pathway to certainty. Litigation rarely delivers certainty in the world of resource development and indigenous peoples. Win or lose, a legal case between resource developers and indigenous peoples does not build positive relations, and rarely delivers project certainty and share holder value. Litigation is the welcome mat to project delays, investor uncertainty and bad local relations. Historically, the resource sector's track record of wins in regards to indigenous litigation is dismal.

Successful aboriginal community engagement incorporates Aboriginal goals of respecting land and resources, and conducting activities in economically, socially and environmentally responsible ways to ensure long-term sustainability. Businesses must be dedicated to creating mutually beneficial relationships with Aboriginal communities with a foundation and commitment to effectively address local concerns, share the project risks and benefits and bring certainty to communities, the developer and its shareholders and in many cases Government.

Partnering for Success: Adding Value in Exploration Through Community Engagement,
Matt Jeschke, Regional Community Relations Manager, Kennecott Exploration Company, Rio Tinto, Salt Lake City, UT

The Business Case

One of Rio Tinto's General Managers recently stated, "Maintaining good community relations is as important as maintaining the plant or the ore body." Similarly, Bruce Harvey, Rio Tinto's Global Practice Leader for Communities, has pointed out that our real assets are our exclusive licenses to access a resource, so that we can operate our business. Without access to our resources, the value of each of our projects is exactly zero.

In addition, delays in permitting or production can cost businesses tremendous sums of money. Media or NGO campaigns can wind up eating up extraordinary amounts of time, including considerable involvement from senior management. Also, the ability to understand and address social and environmental issues is increasingly becoming a key element of securing project capital on the international markets. The World Bank and most of the major

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international banks agree that they want to see companies following clear guidelines in these areas, and that they will not invest in many projects without this commitment to internationally recognized standards. And there are the many legal cases against companies for their social and environmental performance, some of which have dragged on for decades.

There is probably no quicker or easier way to destroy value in the mining business than to mismanage social and community issues.

Of course, let's not forget that the consequences for communities, which are directly affected by the social and environmental activities of companies, are real and lasting. An effective partnership with a community can provide jobs, facilitate sustainable development, and be a catalyst for a positive future. In other cases, mining operations have led to conflict and environmental damage – and the accompanying negative impact on the company's worldwide reputation – that linger for decades.

And yet, efforts by the mining industry to understand and respond appropriately to this "above ground risk" often fall short. There are a number of reasons why this may be the case. Sometimes we waste considerable time debating whether or not concerns raised about our activities are "right" or "justified", and we fail to respond to their issues at hand. Sometimes we may lack the experience or the skills to address the issues, and feel uncertain about what exactly should be done – and fall into inaction as a result.

But many of these issues are easier to address than some may think. And there are considerable opportunities for companies and communities if the issues are addressed correctly, including the receiving of a "social license to operate." I'm not thrilled about this phrase – there is no one moment where anyone ever receives such a license. Instead, the real point is to cultivate and maintain good relationships which provide benefits to companies and to communities. But social license is a good short-hand that describes just why this is so important.

And there is a competitive advantage if we get this right. All of the easiest deposits have already been found and mined. Almost all of the remaining deposits are bound to be more difficult from a social, environmental, or technical points of view. To access these deposits of the future, we need to turn ourselves into the companies of the future.

It's easy to talk in generalities about win-win relationships and being the company of the future. But how do we do it?

Community Relations, Step by Step

It can be particularly difficult during exploration. The nature of exploration means that our on-the-ground presence may be as short as a few weeks, or as long as a decade. But despite the fact that the vast majority of exploration projects will not result in a mine, we always have to remember that our initial interactions with local communities may play a significant role in our ability to access some of the most important deposits of the future.

Because of the uncertainty of our projects, exploration frequently tries to "fly under the radar," often for longer than it should. In some rare cases, this low-profile approach may be appropriate. But we need to make a conscious attempt to engage with communities earlier in the process, as we believe that the changing context for mineral exploration and production demands transparency and proactive dialogue.

This also means understanding the environments where we operate. Before beginning any exploration, we need to make conscious efforts to understand the communities where we will be operating. What towns are nearby? What traditional territories? Has there been

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experience of exploration or mining in the area? Has it been positive, negative, or mixed? If this information is not easily available, find someone who can help you answer these questions. Find a few people. You don't want to limit yourself to receiving one person's biased opinion. But generally if you ask around, it doesn't take long to start understanding the lay of the land.

Depending on where you are operating, consider providing cross-cultural training for staff (not forgetting the "first contact" geologists). Ensure that you understand the history and culture, and legal and governance frameworks, including local traditions that may not be legally binding.

All of this information should go into a project management plan, and a risk register, but be careful that identifying risk is not seen as a substitute for addressing risk. It's not enough to record it on a piece of paper.

There is no substitute for engaging directly with community members. Find someplace to begin – with a town mayor, or official, or anyone who has a clear role in the community. Explain what you intend to do, and provide details – and then sit quiet and listen. Ask questions about what people's concerns are, and above all, ask them who else you should be talking to, and make sure that you talk to more than a handful of people. Keep talking to people and asking questions until you're confident that you have a good understanding of people's views – not only their fears, but also their hopes and expectations as they relate to the project. Take particular care not to encourage expectations that you know are unlikely to be realized.

In many cases, the actions that are needed are not complicated. We need to explain our programs, and their possible impacts. Environmental policies and practices should be explained in detail, with visits to sites offered, so that community members can see how water is protected, and how care is taken in each step of the process.

Wherever possible, hire locally, and use local goods and services. But invest in getting the relationship right, not just the finances and tangible benefits. Miscommunication occurs so frequently and so easily, that we should never forget the importance of spending one-on-one time with people, so that we can exchange ideas and get to a place of understanding.

In addition, it is of course essential that we move away from the old paradigm of providing philanthropic support, in which charitable contributions are provided to worthy causes such as health and education. A company's primary economic contributions should be through its core activities – maximizing benefit through employment, training, and local supply chains. This issue of community economic engagement can get quite complicated, but it begins with the basics of seeking to maximize community participation in an operation's activities.

The fundamentals of community partnership aren't much more complicated than this: know where you are working; engage actively with local community members; provide information and be sure to listen; allow sufficient time for discussion and dialogue; be responsive to people's concerns; and carefully consider the consequences of your activities, in order to minimize or avoid any negative social and environmental consequences, and maximize potential local benefits.

Actually, much of this does not require large new investment but instead new thinking about challenges – including ensuring that a project team has appropriate skills to manage these issues, that timelines are adjusted to allow sufficient time to address these concerns, and that teams work together on management systems, skills development and training.

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Community-Centered Development

What is really needed is an internal culture change as opposed to new technologies or infrastructure. In this way, an approach to change in community relations practices is not dissimilar to the methods employed by the industry some years ago in adopting better health and safety standards and practices. Mining safety today looks remarkably different (better) than safety only 10-15 years ago. I am confident that we'll be saying the same about community engagement 10-15 years from now.

What ultimately should result is a process of community-centered development, where companies partner with communities and involve them directly in decision-making. These companies are careful to not assume ownership over the development process, but instead contribute to it in a meaningful way. They should look for their own "unique contribution" as one of various actors in the development of the community, and focus on the natural overlap between their business activities and the community's development – which usually is, as noted above, involving communities in the economic activity of the project, as directly as possible.

Partnering with communities and third parties for development is instrumental in helping a company obtain a social license to operate while demonstrating to lending institutions and other stakeholders a company's ability to become a catalyst for community development in innovative ways that go beyond the traditional provision of financial resources.

Diavik Diamond Mine

One of Rio Tinto's clearest examples of this type of partnership is at our Diavik Diamond Mine, in Canada's Northwest Territories, near the Arctic Circle. This is a case where we have sought to ensure that we don't just consult with neighboring communities, but actively involve them in all aspects of the mine. There is ample material that has been published about Diavik (see www.diavik.ca) which I will not repeat here, and I will discuss some of their successes (and challenges) in my talk. This example and the examples of many other Rio Tinto operations have given us the confidence that this type of partnership is not only realizable but is necessary in order to be the successful mining company of the future.

ADVANCES IN IDENTIFYING CONCEALED MINERAL DEPOSITS

Chair: **Dave Frank**, *Outreach Coordinator, U.S. Geological Survey, Spokane, WA*

Margins and Gradients of Porphyry Cu Systems Based on Mineral Compositions, *Peter G Vikre, U.S. Geological Survey, Mackay School of Earth Sciences and Engineering, University of Nevada, Reno, Reno, NV ; Frederick T. Graybeal,Chatham, NJ; John McCormack, Mackay School of Earth Sciences and Engineering, University of Nevada, Reno, Reno, NV; Simon Poulson, Mackay School of Earth Sciences and Engineering, University of Nevada, Reno, Reno, NV*

Identification of concealed deposits is critical to maintaining supplies of mineral resources. Porphyry Cu deposits (PCD), which constitute ~65 % of Cu production and resources, occur within larger magmatic-hydrothermal porphyry Cu systems (PCS) of megascopically zoned alteration mineral assemblages that have been successfully used to locate deposits. Cryptic mineral properties have the potential to further expand the detectable margins of systems,

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ADVANCES IN IDENTIFYING CONCEALED.... *(Continued)*
Margins and Gradients of Porphyry Cu Systems... (Continued)

and to define vectors toward thermal and hydrologic centers of systems where Cu was concentrated. We have systematically determined major element, minor element and hydrogen isotope compositions of magmatic and hydrothermal biotite and chlorite distal to intact and eroded porphyry Cu systems in southern Arizona in order to evaluate if compositions of these minerals can be used to identify concealed porphyry Cu deposits. Although the compositions of biotite and chlorite depend on numerous physical and chemical factors (including temperature, activities of major cations and volatiles (Fe, Mg, Al, Si; F, Cl, H_2O), and fO_2), we examined systems that formed within (1) broadly concentric thermal structures, and (2) relatively homogeneous igneous host rocks, thereby reducing the effects of temperature and bulk rock composition on mineral compositions. Further, our strategy was to seek gradients and not focus on thermodynamic quantification of mineral properties.

Initial biotite analyses indicate that mole fraction values of Mg/Fe in 60 Ma large-volume granodiorite and quartz monzonite of the Patagonia Mountains pluton increases toward the Four Metals Cu-Mo breccia deposit (7.8 Mt @ 1.2 % Cu; 0.11 % Mo) of the same age in which $Mg/Fe_{\text{hydrothermal biotite}}$ is >> surrounding $Mg/Fe_{\text{magmatic biotite}}$, and toward the 60-59 Ma Sunnyside PCD (> 1.5 Gt @ 0.33% Cu, 0.01% Mo) 8 km N of Four Metals, in which $Mg/Fe_{\text{hydrothermal biotite}}$ has not been analyzed. $F+Cl_{\text{magmatic biotite}}$ and $Ti_{\text{magmatic biotite}}$ also increase toward Four Metals and Sunnyside, but $F+Cl_{\text{hydrothermal biotite}}$ is > than $F+Cl_{\text{magmatic biotite}}$ and

$Ti_{\text{hydrothermal biotite}}$ is << $Ti_{\text{magmatic biotite}}$ in the Four Metals Cu breccia deposit. The same relationships were determined between Mg/Fe, F+Cl and Ti in magmatic and hydrothermal biotite in the 65-64 Ma Ventura Mo-Cu breccia deposit (3.6 Mt @ 0.24 % Mo; 0.24 % Cu) 3 km W of Sunnyside. ˜$D_{\text{magmatic biotite}}$ shows little and no systematic variation with most values in the range -70 to -85 ‰. $Mg/Fe_{\text{hydrothermal chlorite}}$ zoning, with high values near ore and low values distal to ore, has been demonstrated at several PCDs. Possible causes of Fe depletion in biotite and chlorite, and F+Cl and Ti enrichment in biotite toward the thermal centers of PCS, where most hypogene ore occurs, are degassing and oxidation (increased fO_2) of magmas, deposition of Fe-O and Fe-Cu-S minerals, and incomplete replacement of biotite by chlorite (inheritance).

The Utility of Ground-Based Magnetic Profile Data in Concealed Mineral Resource Investigations, *Mark W. Bultman, Geologist, Tucson, AZ*

The Basin and Range Geologic Province of North America supplies nearly all the copper and most of the gold and silver mined in the United States. Most producing mineral deposits in this region are found in exposed bedrock which occupies only about 38% of land cover. An accurate understanding of the remaining potential for undiscovered mineral deposits in the Basin and Range (and in many other areas) requires knowledge of the structure and lithology of the bedrock that is concealed by relatively shallow basin fill, primarily on the piedmont slopes of the ranges.

Aeromagnetic data does not generally contain enough information for the identification of concealed lithology and precise structural interpretation of magnetic profile data at large scales (100's of meters to kilometers). Total intensity magnetic field profile data acquired near ground level and at measurement intervals as small as 1m includes information on the spatial distribution of near surface magnetic dipoles that in many cases are unique to a specific lithology. These ground-based magnetic profile data display magnetic textures that can be characterized by several descriptive statistics, their power spectra, and their multifractal

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spectra. Based on graphical comparison and textural characterization, the ground-based magnetic profile data can be used to estimate bedrock lithology concealed by over 100m of basin fill in some cases, information which is of great importance to assessing and exploring for concealed mineral deposits. In particular, the multifractal spectra of ground-based magnetic profile data can be used to differentiate exposed lithologies and it is proposed that the right side of the multifractal spectra of concealed lithologies can be matched to the upward continued multifractal spectra of an exposed lithology to help distinguish concealed lithology. The right side of the multifractal spectrum is defined as that part of the spectrum to the right of where $f(\alpha) = 1 f(\alpha) = 1$.

In addition, ground-based magnetic profile data also detects minute differences in magnetic susceptibility of rock over small horizontal and vertical distances and therefore can be used for precision modeling of bedrock geometry and structure, even when that bedrock is concealed by over 100 meters of non-magnetic basin fill sediment. These data contain valuable geologic information from bedrock concealed by basin fill that may not be visible in aeromagnetic data, including bedrock hydrothermal alteration, bedrock faults, and other bedrock structures. Interpretation of these data in the San Rafael basin, southeastern Arizona, has yielded results for inferred concealed bedrock lithologies, concealed bedrock structural geology, and a concealed potential mineral resource target.

This technique has also been applied to prospective mineral resource terranes in Northern Wisconsin that are concealed by glacial drift. Initial results indicate detection of bedrock faults and anomalies that are not visible in aeromagnetic data. Textural interpretation in this region is difficult due to rapidly varying thickness and susceptibility of glacial drift.

Range Studies and Implications for Assessing Mineral Resources, *Joeseph P. Colgan, Geologist, Menlo Park, CA*

The modern Sierra Nevada and Great Basin were likely the site of a high-elevation orogenic plateau well into the Cenozoic, supported by crust thickened during Mesozoic shortening. Although crustal thickening at this scale can lead to extension, the relationship between Mesozoic shortening and subsequent formation of the Basin and Range is difficult to unravel because it is unclear which of the many documented or interpreted episodes of extension were the most significant for net widening and crustal thinning. To address this problem, we integrate geologic and geochronologic data that bear on the timing and magnitude of Cenozoic extension along a ~200 km east-west transect south of Winnemucca, Battle Mountain and Elko, Nevada. Pre-Cenozoic rocks in this region record east-west Paleozoic and Mesozoic compression that continued into the Cretaceous. Little to no tectonism and no deposition followed until intense magmatism began in the Eocene. Eocene and Oligocene ash-flow tuffs flowed as much as 200 km down paleovalleys cut as deeply as 1.5 km into underlying Paleozoic and Mesozoic rocks in an otherwise low-relief landscape. Eocene sedimentation was otherwise limited to shallow lacustrine basins in the Elko area; extensive, thick clastic deposits are absent. Minor surface extension related to magmatism locally accompanied intense Eocene magmatism, but external drainage and little or no surface deformation apparently persisted regionally until about 16–17 Ma. Major upper crustal extension began across the region ca. 16–17 Ma, as determined by cross-cutting relationships, low-temperature

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thermochronology, and widespread deposition of clastic basin fill. Middle Miocene extension was partitioned into high-strain (50–100%) domains separated by largely unextended crustal blocks and was over by 10–12 Ma. Bimodal volcanic rocks erupted during middle Miocene extension can be found across most of the study area but are volumetrically minor outside of the northern Nevada rift. The modern physiographic basins and ranges were formed during a distinctly different episode of extension that began after about 10 Ma and has continued to the present. Late Miocene and younger faulting is characterized by widely-spaced, high-angle normal faults that cut both older extended and unextended domains. Major widening of the Basin and Range at this latitude thus took place during a relatively brief interval in the middle Miocene, and the lack of major shortening west of the Sierra Nevada at this time suggests that the change in the plate margin from microplate subduction to lenthy, transtensional strike-slip played an important role in allowing extension to occur when it did, as rapidly as it did. The onset of extension ca. 16-17 Ma was coeval with both Columbia River flood-basalt volcanism and the hypothesized final delamination of the shallow Farallon slab that was beneath the western United States in the early Tertiary, but it is unclear if these events were necessary prerequisites for extension, simply coincidental, or themselves consequences of rapid extension and/or reorganization of the plate boundary.

Structural Corridors in the Yukon-Tanana Upland, Alaska—A Tool for Understanding Regional Metallogeny in a Concealed Terrane, *Warren C. Day[1], J. Michael O'Neill[1], Cynthia Dusel-Bacon[2], John N. Aleinikoff[1], Richard W. Saltus[1], Rob McLeod[3], Cullan Lester[4], and Christopher Siron[3]*

[1] US Geological Survey, Denver Federal Center, Lakewood, CO, [2]US Geological Survey, Menlo Park, CA, [3]Full Metal Minerals Corp., Vancouver, BC, Canada, [4]Alaska Earth Sciences, Anchorage, AK

The mineral resource potential of the Yukon-Tanana Upland in east-central Alaska, a vast region concealed beneath Quaternary surficial deposits, is poorly known but conceivably quite significant. The Upland is part of the Tintina Gold Province, an arc-shaped, 1,200 km (750 mile)-long metallogenic province extending from northern British Columbia, through the Yukon, and into south-western Alaska. The US segment of the Upland hosts large gold deposits, including the Pogo, Fort Knox, True North, Donlin Creek, and Shotgun, and remains a prime area for gold and base-metal exploration. Current research under the egis of the US Geological Survey *Assessment Techniques for Concealed Mineral Resources Project* in collaboration with Full Metal Minerals, is focused on gold and base-metal resources in the western Fortymile district, approximately 30 miles west of Chicken, AK. Goals of the project are to understand the tectonic evolution of the region, as well as the timing and nature of known mineral deposits and districts, to better guide the development of mineral resource occurrence models. These models are powerful tools to evaluate the undiscovered mineral resource potential in this prospective, yet poorly exposed terrane.

In Alaska, the Upland is bounded by the Tintina-Kaltag fault to the north and the Denali fault to the south, both of which are major right-lateral strike slip faults active since at least the Paleogene. The Upland is transected by several notable northeast-trending faults whose initial age of activation and deformational style is poorly understood. Our recent studies in the Goodpaster watershed, about 40 miles west of the Fortymile district, characterized one of these northeast-trending structural corridors, the Black Mountain Tectonic Zone. The

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zone was active as a major crustal feature that localized mid-Cretaceous (113-107 Ma) plutonism and Paleocene volcanism. The zone, active to present, is marked by pronounced left-lateral strike-slip faulting, which controlled the emplacement of gold-bearing plutons and veins in the Goodpaster River watershed. In extrapolating the concept of northeast-trending structural corridors to other parts of the Upland, we have stepped out to the east of the Black Mountain Tectonic Zone to examine the tectonic history of the northeast-trending Kechumstuk and associated faults in the vicinity of Mt. Veta, AK. The Kechumstuk fault system bisects the western Fortymile mining district and is a prominent feature in the geophysical survey published in 2008 by the AK Division of Geological and Geophysical Surveys and the Bureau of Land Management. Several base-metal prospects that are associated with replacement of Paleozoic carbonate units occur in the area.

New U-Pb zircon ages indicate that the Kechumstuk fault zone was active in controlling emplacement of mid- and Late Cretaceous (110, 98, and 69 Ma) plutons and it potentially localized the ore-forming systems in the western Fortymile mining district. Thus, if our model for the association between mineral deposit formation and northeast-trending strike-slip fault zones within the Upland is accurate, additional undiscovered structural corridors and associated gold and base-metal deposits may be present elsewhere in the Yukon-Tanana Upland.

USGS Studies at the Concealed Pebble Porphyry Cu-Au-Mo Deposit, Alaska, *Robert G. Eppinger, Karen D. Kelley, Eric D. Anderson, Paul Bedrosian, David L. Fey, Burke Minsley, Anjana Shah, and Steven M. Smith, U.S. Geological Survey, Denver, CO*

In collaboration with the Pebble Limited Partnership (formed in 2007 by Northern Dynasty Minerals Ltd. and Anglo American LLC), the USGS is studying the Pebble deposit and the surrounding district to refine assessment techniques for concealed mineral deposits. The Pebble deposit consists of two zones: the partially exposed Pebble West (PW), discovered by Cominco America in 1989, and the concealed Pebble East (PE), discovered by Northern Dynasty Minerals Ltd. in 2005. Combined indicated and inferred resources are 72 billion pounds of Cu, 94 million ounces of Au, and 4.8 billion pounds of Mo.

Geology of the Pebble district consists of Jura-Cretaceous argillite, siltstone, and graywacke cut by intrusions occupying a northeast-trending structural corridor. Subalkalic granodiorite intrusions (91-89 Ma) are genetically related to mineralization. Quaternary glacial deposits up to 50 m thick cover PW; similar glacial material overlies ~300-600 m of post-mineralization Tertiary volcano-sedimentary rocks that unconformably overlie PE.

Aeromagnetic data reveal several large-scale geophysical domains trending NE-SW through the region with the Pebble deposit situated close to a broad boundary between highly magnetic rocks to the southeast and a magnetic low to the northwest. The same boundary separates Jurassic and older magmatic and metamorphic rocks to the southeast, and Triassic to Jura-Cretaceous volcanic and sedimentary rocks to the northwest. The deposit itself lies within an ovoid (approximately 25 by 50 km) magnetic high representing a cluster of Cretaceous and Tertiary plutons and volcanic rocks located northwest of the Lake Clark fault zone.

Magnetotelluric (MT) and gravity data have been collected along a series of regional- and deposit-scale profiles covering an area of over 5000 km^2. The regional gravity data show variations that may indicate the roots of larger igneous bodies such as the granodiorite intrusions associated with the Pebble deposit. Regional MT resistivity models image several

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such bodies, which exhibit a range of emplacement depths and spatial extent. The MT models further show the Pebble deposit to lie within a northeast-oriented, 10-km-wide conductive corridor flanked by resistive crust to >10 km depth. At the deposit scale, notable gravity anomalies near the deposit reflect structural variations, while MT data highlight zones of pyritic alteration peripheral to the deposit. In combination, these data provide insight into the structural controls on deposit emplacement and preservation.

Porphyry copper indicator minerals identified in till samples up and down ice from Pebble include gold, jarosite, apatite, and andradite garnet. The best vectors to the deposit include gold and jarosite. Gold grain abundance and morphology vary with distance from the deposit. Samples directly over the deposit contain 12 times the number of gold grains (largely pristine) compared to those approximately 5 km away (re-shaped and modified).

Geochemical techniques were applied to determine optimal sampling media for detecting buried mineralization. Lake, pond, stream, and seep water samples collected over the deposit contain anomalous concentrations of dissolved Cu (up to 661 μg/l), Mo (up to 18.3 μg/l), F (up to 2.6 mg/l) and SO_4 (up to 84.8 mg/l) compared to distal samples. The highest metal concentrations are generally limited to surface waters over the locally-exposed PW. Perhaps more intriguing are low-level (parts per trillion) metal concentrations for Ag, As, Mo, Sb, U, V, and W in surface waters collected proximal to faults that cut the deeper PE ore body. Total metal concentrations in upper soil horizons identify the shallow PW (Au up to 281 ppb, Cu up to 1830 ppm, and Mo up to 27.1 ppm). Partial leach techniques delineate the deeper PE with anomalous Au, Cu, and Mo, particularly at sites coincident with surface projections of faults. The nonconventional pathfinder elements Cl and V are additional detectors of deep porphyry-type mineralization.

A deposit-scale self-potential survey was conducted to investigate the possible role of electrochemical transport associated with a "geobattery" created by the mineralized zone. Several large self-potential anomalies (-600mV and nearly 1 km in diameter) are consistent with the presence of a shallow subsurface electrochemical cell at PW that may be related to sulfide minerals at shallow depth. Weak self-potential variability over PE is likely attributed to the greater depth of mineralization over this part of the deposit.

Identifying Lithologic Terranes Beneath Cover Using Possibility Theory, *Mark E. Gettings, Research Geophysicist, U.S. Geological Survey, Tucson, AZ*

As part of the U. S. Geological Survey's Assessment Techniques for Concealed Mineral Resources Project, possibility theory has been evaluated as a method for identification of buried lithologies by comparison with the possibility distributions of measures of nearby exposed "candidate terranes". Possibility theory is a general theory of the possibility of occurrence of events in the presence of both uncertainty and less than complete knowledge. The possibility of an event is a continuous variable between zero and one rather than a binary off or on as in probability. Thus, any geologic variables, such as degree of fracturing or percentage of a particular lithology in a formation, can be represented. Probability theory is a subset of possibility theory where the possibility function has only nonzero values at zero (not present) and one (present with absolute certainty). Because of this, probability theory cannot distinguish the case of total lack of knowledge from certainty, whereas possibility theory is able to make the distinction. Possibility functions based on quantitative data, e.g. a histogram of anomaly amplitudes, are directly computed from the appropriate mathematical

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transformation and thus are objective. Possibility functions based on qualitative, linguistic, or subjective data are quantified by simple rules with uncertainties reflecting both the variability of the property and the degree of knowledge of that property. Estimates from possibility theory are conservative and automatically include uncertainty in the criteria estimates; moreover, they overcome the sharp boundary problem of interval analysis. The theory allows logical combinations of the possibility functions for quantitative, semi-quantitative, and qualitative measures; thus many disparate data types can be utilized in the decision process. For quantitative areal data (e.g. aeromagnetic, gravity and electromagnetic surveys), measures within the target and candidate areas that have been used include the distributions within a moving window of: anomaly amplitudes; total number of extrema; elongation ratio (peaks or troughs/all extrema); maximum curvature strike and strike standard deviation; and anomaly surface area. All of these measures contribute useful information for identifying terrane lithology and at least in the study area coincidentally identified some ordering of tectonic events. For semi-quantitative and qualitative (subjective) data, geological map and structural interpretations, trends and distributions of geochemical data, and mineral resource occurrence are used to contour possibility in a spatial (map) distribution. Logical combinations of the various measures (e.g. "A and B and C or D not E") determines a final possibility distribution for each candidate terrane. These distributions determine the overall ranking of the candidate lithologies for the target area. Two examples over covered targets in the Santa Cruz Valley in southeastern Arizona unambiguously identified the targets as intrusive diorite in one case and Tertiary volcanic flows in the other.

NEVADA PROSPECTORS FORUM - PART II

Chairs: **Eric M. Struhsacker,** *Senior Geologist, AuEx, Inc., Reno, NV*
Mark J. Abrams, *Exploration Manager, Agnico-Eagle (USA) Limited, Reno, NV*

Eureka District Exploration Update, Eureka County, Nevada, *Gary Edmondo, Staccato Gold Resources, Reno, NV*

Staccato Gold Resources has been re-evaluating the company's South Eureka Landholdings to provide technical support for additional exploration on the Lookout Mountain – Ratto Ridge trend and the Windfall trend. Utilizing recent advances in stratigraphy and Carlin-style gold models, the company has spent the past two years mapping surface exposures, re-logging old drill holes, and building a 3D geochemical database. This work is being used to re-interpret geology, structure, and mineralization in three dimensions in order to provide necessary technical constraints for resource re-evaluation and exploration targeting.

Historic exploration and mining activities have focused on the Cambrian Hamburg Dolomite-Dunderberg Shale contact, which can be either fault or depositional. Solution brecccia and karst in other stratigraphic units have been noted elsewhere in the district (El Dorado Dolomite at Ruby Hill, Secret Canyon Shale – Geddes Limestone contact at the Geddes Bertrand Mine). Staccato's mapping and re-logging shows significant solution brecciation that occurs throughout the Cambrian sequence and in the Devonian section west of Ratto Ridge. Correlation with gold values in drilling show these features to be important lithologic controls to gold mineralization.

Structural control is important in localizing solution breccia and karst with the primary structural trend being north-south fault zones. East-northeast faults of moderate offset cut

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north-south faults and carry strong alteration and mineralization as well. Minor west-northwest faulting in the Lookout Mountain Pit area localizes higher grade mineralization within favorable host stratigraphy.

Results from these programs will be instrumental in defining additional drill targets for exploration work and will be used to re-evaluate technical aspects on the property to bring the Lookout Mountain resource to pre-feasibility.

New Developments at MacArthur Copper, Yerington Mining Distict, Lyon County, Nevada, *George Eliopulos, Quaterra Alaska Inc., Reno, NV*

Extensional Basin and Range style faulting along east-dipping structure is well documented throughout the Yerington mining district where once near-vertical copper resources are now tilted 60p to 90p to the west.

Quaterra Alaska, Inc's MacArthur property, located near the northern part of the Yerington district, hosts oxide, chalcocite, and sulfide mineralization, all of which is open in two or more directions and none of which has a fully understood origin.

Copper mineralization at MacArthur is hosted in the Jurassic McLeod Hill monzodiorite (field name granodiorite) and the Bear quartz monzonite of the Yerington Batholith, both of which are intruded by four types of Jurassic quartz monzonite dikes and Jurassic andesite and rhyolite dikes.

Oxide mineralization may be exotic, sourced from the west from the tilted, eroded remains of a phyllic alteration zone. Glass limonite, a direct oxidation product of chalcopyrite, suggests an alternative in-situ origin. Recently identified chalcocite mineralization covers a broader area with yet no solid clues as to its origin. Recent, limited drilling has discovered sulfide mineralization which may represent a separate porphyry center.

The Olympic Prospect, Mineral County, Nevada, *Lindsay Craig and Eric Struhsacker, AuEx, Inc., Reno, NV*

The Olympic property, also known as OMCO, lies in the Bell District at the northern end of the Cedar Mountains in eastern Mineral County, Nevada about 10 miles south of the Paradise Peak Mine which produced 1.3 million ounces between 1985 and 1993. AuEx controls the Olympic property, which consists of 114 mining claims leased from A.E. (Gene) Saucier of Sedi-met who over the last decade assembled the claim group and developed a number of drill targets across the property. Both vein and bulk tonnage drill ready targets have been identified on the property.

The district lies on the north-east side of the Walker Lane between Rawhide and Tonopah where northwest-striking strike-slip faults and related conjugate and low angle-faults cut the Tertiary volcanic rocks and underlying basement. The OMCO property contains numerous exposures of rhyolite-hosted low-sulfidation epithermal gold mineralization most notably at the OMCO Mine and Trafalgar Hill areas. Other recognized target environments include Triassic Luning Formation lying at depth beneath volcanic-hosted gold mineralization, an area of andesite hosting high-sulfidation gold, and finally the brecciated margin of a rhyolite dome.

Quartz vein material was first discovered at OMCO in about 1915. Production commenced in 1917 and continued to 1921 utilizing an onsite mill with a cyanide vat leach. Small scale production from leasers occurred between 1921 and 1942 when gold mining was suspended

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during World War ll. OMCO produced about 40,000 ounces of gold from a west dipping 2 to 7 foot-thick epithermal vein that averaged about 0.88 opt. Renewed interest occurred in the district by 1965 and since then a number of companies including Cosmos Resources, Inc., FMC Gold Company, Pittston Nevada Gold Company, and Timberline Resources, Inc. have conducted exploration in various areas with a total of about 71 holes being drilled over an area of several square miles.

Majuba Hill Nevada: Updating the Confusion, Pershing County, Nevada, *E.L. "Buster" Hunsaker III, Hunsaker Inc., Elko, NV*

The 1180 acre Majuba project is centered on the mid-Tertiary age Majuba Hill complex which is about 4,700 feet across. Mapping indicates a near surface to shallow intrusive center. Breccia typically includes tourmaline as breccia matrix, cross-cutting veinlets and disseminations.

Majuba Hill produced outstanding copper with associated gold and silver and is one of the few tin producers (350 tons @ 2 to 4% tin) in the United States. Historical work also indicates silver (up to 40 opt) and gold (up to 0.20 opt). Majuba is best known by mineral collectors as a source of copper, tin, and arsenic minerals. Most of the published geological work completed at Majuba was for uranium (up to 0.15%).

2007 drilling discovered the Myler Zone with significant oxide copper in and around the historic workings. A total of 4,125 feet drilling averaged 0.13% copper and 0.3 opt silver. Phase 2 drilling in 2008 returned two holes with 100 feet of greater than 1% zinc including one 10 foot interval of 9.7% zinc.

Geology and mineral zonation suggests a reinterpretation of the alteration could be significant in expanding the copper, silver and zinc mineralization.

Geology and Sediment-Hosted Gold Targets at the Red Canyon Project, Eureka County, Nevada, *S. R. Koehler, Miranda Gold Corp., and J. M. Hogg, Montezuma Mines Inc.*

Red Canyon is a sediment-hosted gold project located along the Battle Mountain-Eureka gold trend in Eureka County, Nevada. The project covers hydrothermally-altered carbonate rocks that are age-equivalent to gold-bearing host rocks at the Cortez Hills, Pipeline and Gold Bar deposits. Past exploration efforts focused on shallow, oxide gold targets with 95 percent of the drilling less than 500 feet.

Current exploration efforts, to identify drill targets, emphasize systematic data collection and interpretation through: 2,000 scale geologic mapping, stratigraphic refinement with conodont sampling, property-wide geochemical and geophysical surveys, drill hole relogging, and peer reviews. Results illustrate a three square mile alteration cell, with oxidation locally exceeding 1,000 feet, developed in complexly folded and faulted lower plate carbonate rocks of the Horse Canyon, Devils Gate, Denay and McColley Canyon Formations. Southeast-plunging folds occur at regular intervals through the lower plate section. Eight unique target areas are now recognized based on an exploration model that will test for gold mineralization within plunging folds developed in the Denay and McColley Canyon Formations.

(Nevada Prospector's Forum continued on next page.)

A Very Brief Summary of Sniper Resources Ltd's Overland Pass and Guild Au Projects, White Pine and Nye Counties, Nevada, *Doug McGibbon, Vice President Exploration, Sniper Resources Ltd.*

Sniper Resources controls the Overland Pass and Guild Au properties in Nevada under leases from Columbus Gold (U.S.) Corporation. A 13-hole r.c. drill program was completed by Sniper with encouraging shallow oxide Au results encountered in 4 holes in two separate areas at Overland Pass, immediately north of Barrick's Bald Mountain Mine. Planning has been completed for a second drill program that is designed to extend values and to step out from the earlier holes drilled there.

A twenty-four hole r.c. drill program has also been planned by Sniper for the Guild Property, situated a few miles south of Columbus' Bolo project and slightly north of Warm Springs, in Nye County. Jasperoid hosted Au values at the north and south ends of Guild are separated by an area of shallow Tertiary volcanic cover and are believed to be related to an extensive regional mineralizing structure drilled there recently by Cordex Exploration.

Technical reports and other required filings may be found on the SEDAR website under Sniper Resources Ltd. For additional information, Sniper's website is www.sniperresources.com.

Geology of the Rockland Mine Area, Lyon County, NV: Epithermal Au-Ag Mineralization Associated with Late Miocene rhyolite Domes, *Tony Eng, and Mark Reischman, Consulting Geologists, Carson City, NV*

The Rockland mine, located 40 km south of Yerington, NV in the northwestern Walker Lane, produced 50,000 oz Au. Bedrock consists of Mesozoic granitic rocks, late Miocene (~9-7 Ma) sedimentary and lesser volcanic rocks of the Wassuk Group, and a series of late Miocene (7.6 to 5.6 Ma) rhyolite domes and dikes. The NW-trending Pine Grove fault down-drops Tertiary rocks on the east; NNE-trending faults are the main structural control for mineralization.

High level alteration occurs, with stronger chalcedonic silicification, quartz veins and stockworks associated with rhyolite dikes and domes. At the Rockland mine epithermal textures are common, with electrum in high-grade (>10 g/t Au) banded veins; drilling has defined a resource of ~250,000 oz Au. At the Inmet discovery area 3 km east, thick intervals of Au-Ag mineralization occur beneath 100m of altered rock with strongly anomalous As-Sb-Hg. Intercepts include 100-200m of 0.5 to 1.0 g/t Au, with values up to 20 g/t Au and 100 g/t Ag. This area is interpreted as the upper portion of an epithermal vein system. The Rockland mine area bears similarities to other bonanza vein districts associated with rhyolite domes, namely Sleeper, Hollister and Midas in Nevada, and El Penon in Chile. Mineralization formed around 6 Ma.

Geology and Mineral Potential of the South Lida Property, Esmeralda County, Nevada, *Curt Everson and Eric Saderholm, Sirius Exploration, LLC, Elko, NV*

The South Lida Project is a gold exploration property being explored for sediment hosted, Carlin-type and structurally controlled epithermal-type gold mineralization. The Project is located within the Lida Mining District in the south-central part of Esmeralda County, Nevada and is comprised of 100 unpatented lode mining claims owned 100% by Sirius Exploration LLC.

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NEVADA PROSPECTORS FORUM - PART II... *(Continued)*

Geology and Mineral Potential of the South Lida Property

The South Lida Project is located in an area where the southern part of the Walker Lane structural belt merges with the Owens Valley and Furnace Creek faults. The Walker Lane is a major northwest-southeast-trending fault zone that displays right lateral movement that ranges from 30 to 40 miles in its central portion, and hosts a variety of precious metal and base metal mineral deposits.

The geologic setting of the South Lida Project includes a Proterozoic to Paleozoic age sequence of shale, siltstone, sandstone, limestone, dolomite and quartzite which is intruded by a series of Jurassic age intrusives and dikes that range from granite to diorite in composition. Tertiary age sedimentary, volcanic and volcaniclastic rocks form pediment surfaces and fill Miocene and Pliocene topography.

Rock geochemical results established the presence of a potential gold-bearing system. Twenty-nine (29) of the 97 rock samples in the central part of the claim block have greater than 1 ppm gold with the highest gold value equal to 11.45 ppm. Strong, coherent gold in soil anomalies, along with trace elements, suggests several zones that require additional surface mapping and sampling.

Mineral Ridge: Measuring a Great Old District with Modern Benchmarks, Esmeralda County, Nevada, *Robert Todd, P.E., Scorpio Gold US, Spring Creek, NV*

The Mineral Ridge Property is located to the northwest of the town of Silver Peak, in Esmeralda County, Nevada. Production records indicate that the underground mines located on the Mary and Drinkwater deposits produced just over 406,000 ounces of gold between 1864 and 1941 with a further 169,000 ounces of gold produced by open pit mining between 1989 and 2005. Present day geologic and assay data on the remaining resource is well presented but not currently detailed enough to meet the Canadian NI 43-101 compliant resource and reserve requirements. A confirmation drilling and metallurgical program has been undertaken this summer to test the accuracy, quality and reproducibility of this historic data and to provide the rigorous methodology required to support a compliant resource and reserve program.

OPEN PIT MINES & UNDERGROUND MINING - A COMBINATION SESSION

Chair: **Nigel Bain**, *Manager, Goldstrike Underground Division, Barrick Goldstrike, Inc., Elko, NV*

Cooperation on Computer-Based Driver Training to Reduce Accidents, *Mark B. Nelson, President, Framework Solutions, Inc., Midway, UT*

Framework Solutions has developed innovative web-based driver safety training for Barrick Gold and several other leading mining companies. This development effort has resulted in a training product that as part of a comprehensive safety training program has dramatically reduced driving-related accidents at Barrick. This driving course, called Drive First, has been developed to be delivered in instructor-facilitated or self-paced mode and is available in English and Spanish. A version of the Drive First training content has also been released for families of company employees.

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The Mining Safety Roundtable, an organization of mining companies have entered into a unique sharing agreement with Barrick and Framework Solutions to provide several MSR members company-specific versions of the Drive First course.

The modular design of the Drive First training course, and the unique partnerships of the MSR organizations can serve a model of safety training design and cooperation to lower the cost of training development and increase safety.

The presentation will include a description of the course design, the innovative partnership, as well as a demonstration of the Drive First product. It is anticipated that some of the participating partners in this project will be on hand to answer questions as part of the presentation (Barrick, Newmont, Sandvik, FMI,Goldcorp).

Blinded by the Light: The Truth about Airborne LiDAR Mapping, *Ken Wrede, Technical Representative & Project Manager - Mining, Fugro Horizons, Inc., Rapid City, SD*

As open-pit mines in the west continue to grow and profit margins continue to shrink, new technologies must be developed to lower the cost of doing business. Over the past few years, one of the "rising stars" in the field of mine and civil engineering has been **Li**ght **D**istancing **A**nd **R**anging (LiDAR) technology. Developed first to help weather forecasters and pilots identify wind turbulence, terrestrial and airborne LiDAR instruments are now widely used to create very accurate elevation models for mine planning and permitting.

Conventional large-scale mine mapping is tedious and time consuming. This presentation will discuss the "upside" and "downside" of mapping created from LiDAR data sets, compare the advantages and disadvantages of this technology against conventional photogrammetry, and help you decide when LiDAR is the right application for your mapping project.

Review of Performance of Organic Coatings with Expandable Rock Bolt Products, *Francois Charette, P.Eng., M.Sc, Technical Manager, DSI Mining Canada, Salt Lake City, UT; Matt Slatter, Product and Development Engineer, DSI Mining Americas, Roland Walker, B. Eng., Engineering and Technical Manager, DSI Mining Americas, Jim Cullinane, DSI Senior Technical Sales, DSI Mining Americas*

The need for anti-corrosion coatings has existed for many years in the ground support industry, and used with traditional rock reinforcement products, the industry coating preference has been hot-dip galvanizing due to its performance characteristics in typically corrosive environments and low cost nature. However, the hot dip galvanized coating has limitations and is not well suited to expandable rock bolts. As such, for expandable rock bolts, coatings need to be resistant in abrasion, highly flexible (resistant to flexure during the unfolding of the bolt profile) and long lasting in various corrosive environments. This paper highlights some of the critical limitations of various coatings and provides selection criteria for coatings used with water expanded rock bolts and other ground support products. Case studies will also be presented as a measure of the performance of the different coatings.

Mapping - The Haulroad to Success?, *Ken Wrede, Technical Representative & Project Manager - Mining, Fugro Horizons, Inc., Rapid City, SD*

In an industry that relies heavily on the coordinative effort of geologists, mineral economists, engineers, managers, and operations personnel, the "mine map" is a focal point for mining operations from startup to final reclamation. Whether you're chasing a "hot prospect", opening

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an underground mine, permitting an expansion, or desiring to update your pit contours, quality topography and geo-referenced imagery should be near the top of your wish list.

In this technical presentation you will learn about the "little black box" that is the science of photogrammetry. Understanding the basic principals will help you; speak the language, ask the right questions, choose appropriate technologies and products, write a quality RFP, and best of all, save those important budget dollars for a better company picnic.

MINE WATER TREATMENT - THE STATE OF TECHNOLOGY TO MEET INDUSTRY AND REGULATORY DEMANDS

Chair: Scott Benowitz, *P.E., President, Water Engineering Technologies, Inc., Bozeman, MT*

Looking Forward in Water Treatment Processes for the Mining Industry, *Dave Christophersen, VP/ Technical Director, Chris Howell , Engineered Solutions Sales Manager, Crown Solutions – A Subsidiary of Veolia Water Solutions & Technologies, Vandalia, OH; Scott Benowitz, President, Water Engineering Technologies, Inc., Bozeman, MT*

As the water treatment requirements get stricter and more contaminants get added to the constituents-of-concern list, treatment designs and process technologies are evolving to meet these challenges. The solutions include chemical, mechanical, biological, new technology, improvements to old or existing technologies, and often times creative integration of systems, chemistries, and processes. Some approaches that have been recently implemented or are under development include:

- Chemical precipitation and absorption technology with enhanced coagulant application and use of specialized coagulants to precipitate or chelate metals prior to ultrafiltration. This approach has been successful at reducing the concentrations of metals such as mercury to single digit ppb and ppt levels. In this process, commonly used coagulants are applied with sludge recycle control and then specialized metal precipitating chemicals and polymers are used to polish the residual metals so that they adhere to the recirculated sludge and settled or are filterable by effective filtration barriers such as ultrafiltration.
- Implementation of ceramic membrane designs for corrosive waters or those requiring rigorous cleaning procedures that polymeteric membranes could not tolerate. These systems can be used to treat regenerant streams from other treatment processes or other produced streams as part of an integrated system design that results in higher overall recovery rates.
- Biological treatment to manage metals, organics, and nitrogen removal. Improved treatment systems require the proper design and then subsequent operational management to maintain consistent and reliable bacteria colonies to achieve a broad constituent-of-concern duty and may be able to eliminate other systems that may typically have been required.
- Integrated chemical and high recovery membrane systems to manage high silica, boron, and total organic carbon removal at high overall recovery rates to reduce the waste streams from the treatment process while achieving discharge or reuse compliance.

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- Low pH solutions to membranes to remove high concentrations of metals cost efficiently with minimal reagent use.
- Implementation of dense sludge production wherever practical.
- Vibration technology with membrane systems for high recovery rates and high purity with low scaling.
- Evaporator technologies integrated with high recovery systems for more cost effective zero liquid discharge (ZLD) systems.
- Metals removal and recovery with resins or new types of media. One new process under development includes a specialized media in a fluidized bed design. After selective loading of the media by metals such as selenium, the media is regenerated with a weak acid solution. The regenerate is then treated by a specialized membrane system that separates the acid for reuse and provides a high metals concentrate for reuse or sale.

To achieve the desired results, a solutions approach is one of the best starting points with the following questions that need to be asked:

1. What are the needs now and in the future for the site including closure?
2. What are the needs and limitations to consider as a solution is sought?
    a. Cost restraints, capital and operating.
    b. Water flows: average, minimum, and peak.
    c. Water analyses and variations in all constituents.
    d. Discharge and compliance limits if there is a discharge flow.
    e. ZLD.
    f. Reliability.
    g. Footprint.
    h. Ease of operation and manpower requirements.
3. Select from the market place the best technology partner with the best available technologies and create the optimal integration of systems, processes, and chemistries.
4. Perform treatability studies.
5. Pilot if appropriate and possible to further evaluate and develop the treatment process to validate the treatment strategy and optimize for full system design.

Historical Review of Biotreatment for Mine Water, *James R. Fricke, Principle, Resource Environmental Management Consultants, Inc., Midvale, UT*

This discussion attempts to provide a historical review of the discovery and development of biotreatment processes for mine discharge waters. Since the enactment of the CWA, operating mines have been held to allowable contaminant discharges through the NPDES permit program, and abandoned mines have posed environmental threats for the past 150 years. Observations of the amelioration of mine water discharge following passage through naturally occurring Sphagnum bogs in Ohio and West Virginia led to the hypotheses that created the biotreatment technology we have today, with further development and implementation of the technology driven primarily by the need for low cost, passive water treatment methods at operating and abandoned mines throughout North America. The

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discussion is not an exhaustive presentation on all biotreatment methods, rather it intends to provide the audience with background information about the discovery, study, development and implementation of biotreatment technology by academia, government and industry over the last thirty years.

Huntsman et al. (1978) and Wieder and Lang (1982) first noted amelioration of AMD following passage through naturally occurring Sphagnum bogs in Ohio and West Virginia.

Permitting Requirements for Evaluation and Selection of Mine Water Treatment Systems,
Doug Parker, Executive Vice President and Scott Mason, Hydrometrics, Inc., Kalispell, MT

Water treatment systems associated with active and inactive mine operations may require permits, regulatory approval and environmental analysis in order to be constructed. Agency approval or permit requirements may also impose conditions on the water treatment system beyond simply meeting effluent limits or discharge standards.

Regulatory agency approval process involving federal lands will require NEPA review which increasingly includes detailed analysis of treatment technologies and may look at alternative treatment scenarios as part of the NEPA analysis. Although agencies may or may not have the technical expertise to evaluate treatment technologies their selection criteria may be different from mining company criteria.

Historically, agencies generally viewed water treatment (as they often did mining and milling operations) as a black box and were primarily concerned with the treatment system results. Increasingly agencies are asking for detailed information about system components. Agency review requirements may include requests for pilot test results and detailed design information during the NEPA analysis when this level of detail is not available for other mining and milling components and prior to selection of a preferred alternative. Additionally, agency decisions may be so specific as to dictate details of treatment systems and thereby limit flexibility in final design or system startup and operation. Dictating system components or treatment technologies in permits or agency decision documents can unnecessarily limit a company's operations and not provide the best environmental outcome.

Due to the site specific nature of water treatment design and operation, maintaining maximum flexibility during the design and construction phases is important to allow changes and improvements to water treatment systems based on operational feedback. One way to provide flexibility to operators is to have the NEPA analysis cover the range of treatment system alternatives, but to have the agency decision documents and permits focus on performance rather than system design or specific components.

Secondary environmental impacts such as disposal of waste streams from reverse osmosis or ion exchange systems and risks associated with chemicals required for treatment must be evaluated in the NEPA analysis and may be significant enough to limit treatment technology selection. However, in most cases disclosure of such potential impacts as well as system robustness, simplicity of operation and costs should be the primary environmental analysis goal rather than selection of a specific technology.

Through the miracle of chemistry there are literally dozens of ways to remove metals from water. When EPA and the State of Montana asked proposals for technologies to treat Berkley Pit water they got an enormous response and pilot tested a number of "innovative" technologies. Unfortunately the lesson learned appears to have been that the industry tried

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and true systems are more reliable and less costly than the offered alternatives. While that is not to say that technological advances will not continuously improve water treatment performance and hopefully reduce costs. However, it is dangerous to assume as the EPA and some states appear to be doing that future technology will allow cost effective removal of nutrients and metals to the low part per billion level.

Beware the New US EPA CERCLA Financial Responsibility Requirements, *Cliff Yeckes, P.G., CEM, MBA, Senior Vice President, Willis Environmental / Mining Practices, Denver, CO*

CERCLA (Superfund) requires that certain industries establish and maintain financial responsibility or assurance (FA) consistent with the risk from the hazardous substances they work with. This assures cleanup costs for their environmental incidents aren't borne by the public in the event of operator or owner insolvency or dissolution. Historically FA has been inadequate, unevenly applied or unenforced, but this is changing rapidly. Because of a recent Federal Court Decision, the USEPA has identified the Hardrock Mining Industry as a priority for developing new FA requirements and will propose a rule addressing this by spring 2011. Mine water treatment will have a significant impact on operators' permitting, financial assurance estimates and long term obligations. Awareness and understanding of the significant financial impact from this rulemaking on the mining industry is critical.

This technical session will include a brief history and analysis of the current legal basis for the rule making, the financial ramifications to mining and how to stay current with and participate in the rulemaking process. An interactive discussion of the products available to satisfy the FA requirements and the process for obtaining them will also be provided.

Regulatory Perspective on Mine Water Management Requirements in the Future, *Patty McGrath, Regional Mining Coordinator, U.S. Environmental Protection Agency (EPA), Region 10, Seattle, WA*

EPA's overall mission is to protect human health and the environment. This includes ensuring that surface water and ground water resources are maintained or improved for aquatic resources and human uses. The management of water impacted by mining and water treatment at mine sites is critically evaluated during review and permitting of proposed mines, permitting and compliance at operating mines, and remediation at mine clean-up sites.

It is important for the industry to understand EPA's role in regulating water-related issues at mining sites, this includes implementation and oversight of the Clean Water Act and Safe Drinking Water Act, compliance and review under the National Environmental Policy Act, and implementation of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). In this presentation, potential future requirements for mine water management under these laws and their implementing regulations will be discussed, in terms of both regulatory/policy changes and, consequently, how science and water management practices are improving. For example, potential changes to water quality standards and mine water discharge technology-based requirements are upcoming. These requirements form the basis for mine water treatment performance standards. Predictive modeling is often used in order to determine if mining operations or mine water remediation can meet these standards. Advanced modeling methods have allowed EPA and other agencies to make

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more informed decisions regarding mine water management. Growth in the use of active treatment technologies at mine sites has resulted in improved compliance.

In addition, there are recent initiatives (Good Sam) and new initiatives (Green Remediation at Mine Scarred Lands, Green Power Imitative) that can be utilized by the industry to advance protection of water resources at mine sites.

Adequate financial assurance is crucial to ensure that mine water management is maintained in the future, particularly where long-term water treatment is needed. EPA Region 10 developed a Regional Mining Financial Assurance Strategy that describes our approach toward attaining this goal. Nationally, EPA is evaluating rulemaking to develop financial assurance requirements for hardrock mining under CERCLA Section 108(b).

The new Administration has emphasized the need for using good science and improving transparency. These objectives are important to our work on mining sites and in implementing the programs described above. We believe that good mining practices can continue and thrive under these objectives.

Advancing Water Treatment at Marlin, *Lisa J. Wade, Environment Director, Goldcorp Inc., Europlaza World Business Center, Guatemala C.A.*

Goldcorp Inc. has a significant presence in Central and South America and in some areas the regulatory framework is not clear. The starting point of water treatment is to ensure compliance with the regulatory standards of the country of operation, however, significant effort goes into the design process to achieve objectives well beyond simply regulatory compliance. Future projects that are being designed now typically consider four major aspects: regulatory compliance, additional risk based standards, a holistic consideration of the site-wide water management plan, and the optimum technology for the long term. A thoroughly reviewed design that considers all four of these aspects will not typically result in the least expensive option for the short term, however, if weighed against the reduction of long term safety, environmental, social, and political risk the added costs are not only justifiable, but also necessary.

Goldcorp's Marlin Mine is located in Guatemala and is a typical cyanide milling operation producing approximately 250,000 ounces of gold per year. The mine commenced operations in late 2005 and continues to date. The original design considered an INCO/SO_2 plant for destruction of cyanide from the tailings, and planned for two years of water quality monitoring within the Tailings Storage Facility (TSF) to determine if additional treatment would be required prior to discharge from the TSF to the environment. The water balance during the design phase indicated that discharge of excess water from the TSF would be required at some point after the first two years. Due to the climatic conditions of the area and the potential for future discharges of excess water, the design contemplated placement of the INCO/SO_2 system at the point where the tailings are leaving the Process Plant and prior to their deposition within the TSF. Geochemical modeling during the design phase indicated that the expected water quality in the TSF would result in certain parameters of interest that could potentially exist at levels above discharge standards.

The INCO/SO_2 plant resulted in WAD cyanide levels in the TSF less than 0.5 mg/L, and monitoring of the supernatant of the TSF was conducted on at least a monthly basis upon start-up. Results of the monitoring over the first two years of operations reported

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concentrations of the following parameters approaching, or slightly above an applicable standard: Total Cyanide, Mercury, Copper, Iron, and Nitrates. The actual data combined with an updated water balance more accurately predicting future discharge years, resulted in a revised water management strategy at Marlin. This included optimizations to: the INCO/SO_2 plant, tailings management, and the addition of a water treatment plant for tailings water. The Marlin Mine guarantees compliance with the applicable water quality standards and continues to increase water use efficiency each year as a result of the optimizations conducted.

notes