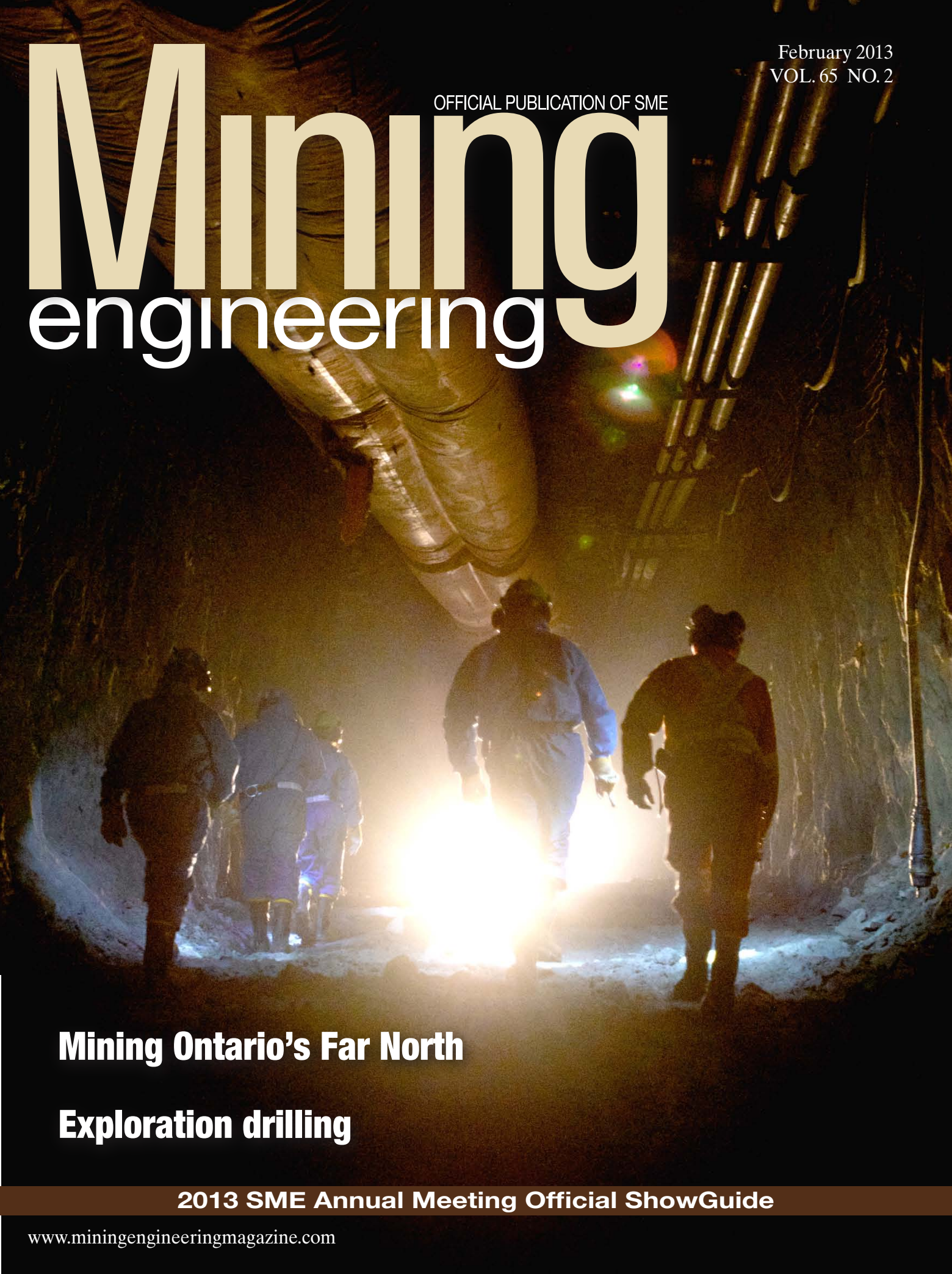




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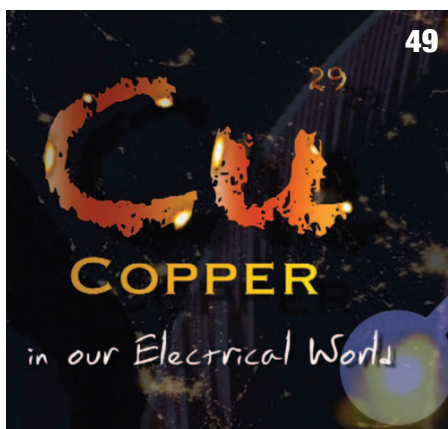
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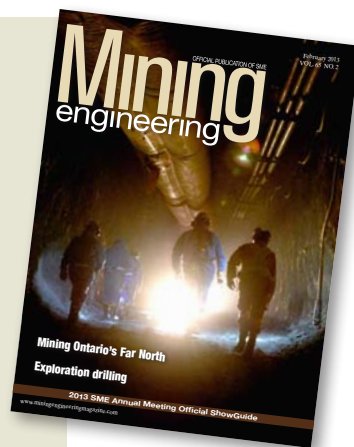
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In This Issue

More than 26 percent of all exploration dollars spent in Canada are invested in Ontario. The mining industry was expected to invest about C\$3.8 billion in Ontario in 2012. Not only does the province hold vast amounts of minerals, the government is encouraging mineral development, page 22. Attendees at the Northwest Mining Association in December were warned of a rough four years following November's election, page 34. Cover photo shows Lake Shore Gold's Bell Creek Mine. Photo courtesy of the Ontario Ministry of Northern Development and Mines.

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As term comes to a close, it's time to focus on the future of the Society



by Drew A. Meyer
2012 SME president

This issue completes my term as the 2012 SME President. Usually, the final President's Page is used to write about the activities and accomplishments of the Society during the previous 12 months. The good news is that both activities and accomplishments were again extraordinary. In order to give those activities and accomplishments suitable recognition, we will again issue an annual report – started last year – which will be made available to all members on the SME website in the members-only section. The annual report will allow me to focus my last page on the future rather than the past.

We are fortunate to have a strong professional staff under the able direction of Dave Kanagy and, equally important, a very large number of dedicated, highly competent volunteers who have given their time and expertise many for years and decades. And we cannot forget to recognize the support of the many companies that make monetary contributions to SME and support their employees in volunteer activities. None of this comes without cost or without sacrifice. Nor does success come without focus.

The governance changes made in 2006 and the Strategic Plan completed in 2010 have been a crucial part of keeping our Society – leadership, volunteers and staff – focused on what is important to members and enabling our limited funds to be directed to the areas that most benefit the greater mining community.

As a society of professionals, education, in all its forms, is an essential part of our mission for all who produce and benefit from mining and its products. The awarding of scholarships is likewise an essential part of our support of education. The importance of our commitment to scholarships was brought home to me when recent articles in the *Wall Street Journal* and *USA Today* highlighted the sharply rising cost of tuition at our nation's colleges and universities. There are many reasons for the increase, and

public and private institutions as well as those that are not-and-for-profit are affected, albeit to different degrees.

According to the U.S. Department of Education, average total tuition, room and board rates charged by public four-year institutions rose from \$2,550 for the 1980-1981 school year to \$15,918 for the 2010-2011 school year. For the same period, the total cost was more than double for private not-for-profit and for-profit four-year institutions – \$5,594 to \$32,617 respectively. On average, it now takes \$64,000 to \$130,000 to obtain a four-year degree. It's no wonder that student loan debt is approaching \$1 trillion, most of it held by the federal government. For perspective, auto loan debt is about \$750 billion and credit card debt is about \$700 billion.

The governance changes made in 2006 and the Strategic Plan completed in 2010 have been a crucial part of keeping our Society – leadership, volunteers and staff – focused on what is important to members and enabling our limited funds to be directed to the areas that most benefit the greater mining community.

SME provides scholarships through its SME Foundation, as well as its divisions and sections, with the Woman's Auxiliary of AIME (WAAIME Division) leading the way with more than \$260,000 domestically and internationally, in 2012. As SME approaches \$500,000 in scholarship distribution annually, we are providing a significant benefit to those students interested in pursuing a career in mining. We realize however, that we can and must do more. At the 2013 Annual Meeting in Denver, we will announce a major new initiative to dramatically increase the funds available for all of the Society's programs, but scholarships in particular, and education in general, will be in the forefront.

We can all be proud of our past going all the way back to the formation of the American Institute of Mining Engineers in 1871. Now we look forward to the future of SME and the greater mining community, and realize it is our time to help shape the future by supporting those who are the future. ■

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Court rules Teck is liable for smelter wastes in US waters

A U.S. federal district court judge ruled that Teck, a Canadian mining company, is liable for the costs of cleaning up contamination in the Columbia River south of the border from decades of dumping slag and effluent from the company's Trail operations in Canada.

In his decision, Judge Lonny Suko ruled that, "for decades Teck's leadership knew its slag and effluent flowed from Trail downstream and are now found in Lake Roosevelt, but nonetheless Teck continued discharging wastes into the Columbia River."

Judge Suko noted that the company admitted treating the international waterway as a free waste disposal service. Specifically, the judge found that from 1930 to 1995, Teck intentionally discharged at least 9.04 Mt (9.97 million st) of slag that included heavy metals such as lead, mercury, zinc and arsenic.

The judge also found that Teck knew the hazardous waste disposed of in the Columbia River was likely to cause harm.

The decision gives the U.S.

Environmental Protection Agency (EPA) the ability to force Teck to pay for the cleanup and, potentially, for any ongoing damages and losses that result from the ongoing contamination. That issue has yet to be determined by the court, *The Globe and Mail* reported.

Some believe the landmark case could have implications for mining and other industrial interests on both sides of the border. The Canadian government, the province of British Columbia and the U.S. National Mining Association have all intervened in the case to argue that the issue should be resolved bilaterally.

Eight years after the case was launched and on the eve of a trial this fall, Teck admitted to discharging slag and liquid effluent into the river from 1896 to 1995. But it argued that the U.S. law that forces companies to clean up contamination sites, known as the Superfund law, was never intended to reach across the international border.

But Kristie Elliott, lawyer for the Washington state attorney-general, said complaints about the contamination from the Trail smelter

surfaced as early as the 1940s, when farmers from Washington state sued Cominco, Teck's predecessor, over air pollution from the smelter. That case was eventually resolved in arbitration by the two federal governments and set a precedent for cross-boundary pollution law.

The company took out insurance to cover liability but didn't stop discharging effluent for decades, she said.

Teck has spent about \$1.5 billion modernizing Teck's Trail operations over the past 25 years. A new furnace installed in 1996 cut emissions dramatically.

In November, Teck completed a \$5.8-million project to reduce the risk of a spill into the river.

The company is now installing a \$1.2-million automated leak detection system and a \$125-million acid plant that will reduce sulfur dioxide emissions a further 15 to 20 percent.

Recycled lead makes up about 20 percent of total production and anything that can be used or recycled is, right down to granules of slag, sold for processing into portland cement. ■

SEC approves physical copper fund

THE U.S. Securities and Exchange Commission (SEC) approved the first exchange-traded fund (ETF) in the U.S. that would allow investors to buy copper, despite complaints from some manufacturers and merchants that such a fund would put too much of the metal in the hands of investors, making it more scarce.

The proposed JPM XF Physical Copper Trust would be backed initially by 61.8 Mt (68.1 million st) of actual metal. Currently available copper ETFs are backed by futures.

J.P. Morgan Chase & Co. said it plans to list the ETF on NYSE Arca,

a division of NYSE Euronex. A date for the listing hasn't been released. J.P. Morgan and NYSE Arca declined to comment, *The Wall Street Journal* reported.

The SEC approval was the final hurdle in a 26-month process for J.P. Morgan. The investment bank had amended its request at least five times to answer the SEC's questions and address concerns by U.S. copper users.

Copper manufacturers and merchants wrote to the SEC to oppose the planned ETF, saying it would hurt the industry by locking up too much copper in investors' hands. Copper users say a copper-linked

product could disturb a delicately balanced market that has faced production shortfalls for three of the past four years.

"We think it's a sad day for consumers of the metal," said Bob Kickham, senior vice president of procurement at Luvata, a copper-parts maker that had lobbied the SEC to block the ETF.

Copper is widely used in electrical wiring and pipes.

In its approval filing, dated Dec. 14, 2012, the SEC said it didn't believe the copper ETF was "likely to disrupt the supply of copper available for immediate delivery." ■



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Mine fatalities second lowest in 2012; MSHA data counts 36 deaths in US mining second lowest in history

PRELIMINARY DATA from the U.S. Department of Labor's Mine Safety and Health Administration (MSHA) indicates that 2012 was the second best year in terms of fatalities in the nation's mines. The data shows that 36 miners lost their lives in fatal accidents in 2012; 17 in metal/nonmetal and 19 in coal. This is the second lowest level of recorded fatalities compared to 2009, when there were 35 fatalities.

West Virginia led the nation in 2012 with seven coal-mining deaths, according to preliminary figures from the MSHA. The fatality count for 2012 was one more than the six West Virginia coal miners killed in 2011.

Across all types of mining, the industry's total fatality count in 2012 was 36, down from 37 in 2011. Year-over-year record improvements in safety performance were interrupted in 2006, and again in 2010, with mine disasters at the Crandall Canyon and Upper Big Branch mines, respectively.

Kentucky had the second most coal-mining deaths in 2012, with four. Alabama had two, and Colorado, Illinois, Indiana, Ohio, Tennessee and Virginia had one each.

West Virginia has led the nation in

coal-mining fatalities in five of the last dozen years. Kentucky led the nation six times during that period, and Utah led once, in 2007, when nine workers died in the Crandall Canyon Mine disaster.

On Dec. 21, the Obama administration outlined new timelines for several key mine safety initiatives, as part of the publication of the government-wide, semi-annual regulatory agenda.

The MSHA regulatory agenda says the agency will finalize by May a proposed rule to require "proximity detection" devices that would shut down certain underground mining equipment when workers get too close, to help prevent injuries and deaths caused by collisions.

MSHA also says it will finalize by June its long-awaited rule aimed at reducing miners' exposure to coal dust that causes Black Lung Disease. A new rule on how to handle increased enforcement at mining operations that exhibit patterns of violation was due to be finalized in January. And a second proximity device rule, to expand the requirement to other mobile underground equipment, is to be published in draft form in July,

MSHA said.

The black lung rule in particular has been basically stalled since not long after it was proposed in October 2010, in part because of opposition from industry and from Republicans in Congress, the *West Virginia Gazette* reported.

In 1969, Congress made eliminating black lung a national goal, with a law that required mine operators to take steps to limit exposure. The law greatly reduced black lung among the nation's coal miners.

Scientists have found, though, that black lung is on the rise again. Researchers have warned of a doubling of black lung rates since 1997 and of an alarming incidence of the disease among younger miners, whose entire careers took place under the 1969 law's dust limits.

In West Virginia, more than 2,000 coal miners died of black lung between 1995 and 2004, second only to Pennsylvania, with 4,234 black lung deaths during the same period, according to government data. Nationwide, black lung killed more than 10,000 miners during those years. ■

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Mining bill a top priority in Wisconsin

SEC defends Dodd-Frank payment disclosure rules

THE RULE implemented by the U.S. Securities and Exchange Commission (SEC) that requires oil, mining and gas companies to disclose payments made to foreign governments has been challenged by four business groups.

The SEC responded to a lawsuit filed in October and defended the rule, which was mandated by the 2010 Dodd-Frank financial regulation overhaul, saying it would not "second-guess" decisions made by Congress, *Reuters* reported.

Groups including the U.S. Chamber of Commerce and the American Petroleum

Institute have argued the rule went beyond the intent of Congress and puts U.S. firms at a competitive disadvantage.

In a brief filed in a Washington federal appeals court, the SEC said the legislative history of the law made clear the provision was crafted by Congress to address the "resource curse," or the phenomenon of resource riches leading to corruption in poor countries.

"Petitioners, ultimately, unhappy with Congress's determination to compel

(Continued on page 19)



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• **Lucas Moore**

Sr. Research Scientist, Kemira Minerals Processing,
Atlanta, Georgia

*"Removal of Inorganic Contaminants
from Mine Effluents"*

Tuesday, January 22, 2013
2:00pm MDT

• **Roderick Eggert**

Professor and Director, Division of Economics and
business, Colorado School of Mines

*"What factors drive metal prices?
Historical evidence, 1900-2012"*

Tuesday, January 29, 2013
9:00am MDT

• **Yi Luo**

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BHP Billiton to sell Navajo Mine; Navajo Nation will take control of coal mine in New Mexico

BHP BILLITON announced that it has reached a preliminary agreement to sell the Navajo coal mine in New Mexico to the Navajo Nation.

Officials said it would preserve 800 jobs at the 13,000 ha (33,000-acre) mine and nearby Four Corners Power Plant, which is the sole user of the mine's coal.

"Bottom line: This preserves the jobs," said Norman Benally, spokesman for BHP Billiton's New Mexico Coal unit.

Under the agreement, BHP Billiton would continue to operate the mine until July 2016. At that point, the Navajo Nation would take over with its own company, or another

company of the tribe's choosing. Mine employees and equipment would stay on with the new operator, *The Farmington Daily Times* reported.

For the tribe, the deal represents a dramatic change from leasing its land to a foreign multinational corporation to exploiting for itself the rich coal veins that stripe the northeast edge of the sprawling reservation. The mine produces about 8 Mt/a (8 million stpy).

"In a larger sense, we're talking about Navajo Nation sovereignty, we're talking about owning our assets," said Erny Zah, spokesman for Navajo President Ben Shelly. "It's definitely a positive for Navajo to assert control and ownership of the natural resources that are on the Navajo Nation."

The mine is the sole supplier for Four Corners, a 2,100-MW coal-burning power plant that is a key supplier for the West's electricity grid.

Plant operator Arizona Public Service Co. said it would pursue an agreement with the Navajo Nation to continue supplying the plant with coal.

The agreement pushes back the Arizona utility's plan to partially decommission the plant by the end of this year. APS now plans to close three of the plants five units in spring 2013.

The mine and power plant stand to lose about 300 jobs when the decommissioning occurs. Officials said the job cuts will happen through normal attrition, not layoffs. About 800 jobs would remain. ■



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Pattern of violations rule revamped; MSHA issues new rule that it says will strengthen its hand

THE U.S. MINE Safety and Health Administration (MSHA) issued a revision that it believes will strengthen its current pattern of violation (POV) program, allowing the agency to strengthen its hand to respond to dangerous mining conditions.

The rule was announced Jan. 17 by Secretary of Labor Hilda L. Solis and has been submitted to the *Federal Register* for publication and will be subject to public review.

MSHA determined that the existing regulation does not adequately achieve the intent of the Mine Act that the POV provision be used to address mine operators who have demonstrated a disregard for the

health and safety of miners. Congress included the POV provision in the Mine Act so mine operators would manage health and safety conditions at mines and find and fix the root causes of significant and substantial violations, protecting the health and safety of miners.

The revised rule retains the existing regulatory requirement that MSHA review all mines for a POV at least once each year; eliminates the initial screening and the potential pattern of violations notice and review process; eliminates the existing requirement that MSHA can consider only final orders in its POV review; and mirrors the provision in the Mine Act for termination of a POV.

In addition, in response to commenter concerns, the preamble to the final rule addresses MSHA's Monthly Monitoring Tool for Pattern of Violations that operators can use to monitor their compliance performance, and MSHA's commitment to requesting stakeholder input to revisions of the specific criteria. In response to commenters' due process concerns, the final rule allows that an operator submit a corrective action program; request a meeting with the district manager to discuss discrepancies in MSHA data; and request expedited temporary relief from a POV closure order.

The rule will become effective 60 days after being published in the *Federal Register*. ■



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Uranium mining in Virginia passes first legislative hurdle

LAWMAKERS IN Virginia recommended that regulations for the mining of uranium be developed. Those rules — and whether a 30-year ban on such mining is lifted — ultimately would need to be approved by the General Assembly for mining to begin, but the recommendation was the first legislative hurdle in the process, *The Associated Press* reported.

The Coal and Energy Commission voted 11-2 in support of legislation proposed by Sen. John Watkins that would have the effect of limiting mining to one company, Virginia Uranium Inc., and the only known, commercially viable deposit of uranium in the state, a 54-kt (119-million-lb) deposit in the state's southern tier that is the largest in

the U.S. It is valued at \$7 billion. The bill also would set forth rules for the company's mining operation.

Virginia Uranium welcomed the commission's recommendation and deemed it an important step by a panel that has grappled with the issue for years.

The General Assembly is expected to take up uranium mining in its 2013 session.

Full-scale uranium mining has never occurred on the East Coast. Critics contend there are environmental concerns if a catastrophic storm or torrential rains slammed southern Virginia. The deposit is in the region along the North Carolina line, and is where radioactive waste would be stored for generations.

Virginia Uranium contends mining the Coles Hill project and the milling can be done safely using best industry practices. It has said it will store the waste in below-ground containment units.

Critics contend that allowing uranium mining at the Coles Hill deposit could lead to other mining in other parts of the state, including central and northern Virginia, where mining companies have shown interest in possible uranium deposits.

Virginia Uranium has said the expected life of the uranium mine would be 35 years. It would employ approximately 350 people, the company has said, pressing an economic argument in an economically weak area. ■



EPA chief decides to step down; Regulations expanded during Lisa Jackson's four-year term

THE U.S. Environmental Protection Agency (EPA) will begin the new year under new leadership, following the Dec. 27 announcement from chief Lisa Jackson that she will be stepping down from her post after four years.

Jackson's four years at the helm of the EPA were marked by battles with Republicans, who fought her proposed environmental regulations.

Under her leadership, the agency declared for the first time that carbon dioxide was a pollutant that could be regulated under the Clean Air Act, leading the EPA to develop a new regulatory regime to limit carbon emissions, reported *Reuters*.

President Barack Obama thanked Jackson for her service, praising her

work on mercury pollution limits, fighting climate change and helping set new fuel economy standards.

"Under her leadership, the EPA has taken sensible and important steps to protect the air we breathe and the water we drink," President Obama said in a statement.

Jackson led the EPA at a time in which its regulatory reach expanded greatly, leading to battles with Republican lawmakers, who accused her of orchestrating massive regulatory overreach that they said was choking U.S. economic growth.

In her statement, Jackson, the first black administrator of the EPA, said she was "confident the (EPA) ship is sailing in the right direction."

Leading the list of potential

replacements for Jackson are Bob Perciasepe, deputy EPA administrator and Kathleen McGinty, a former head of Pennsylvania's Department of Environmental Protection and a protégé of former U.S. Vice President Al Gore.

"Lisa Jackson has shown an unwavering commitment to the health of our families and our children," Obama said.

Jackson's shepherding of new fuel economy standards "will save the average American family thousands of dollars at the pump," Obama said.

Reports have suggested that Jackson, a chemical engineer by training, might be considering a position at a major university. ■



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The ideal candidates should hold a PhD degree in a related field preferably in mining engineering or mining operations research or industrial engineering along with a suitable academic and publications record, excellent analytical and programming skills (C and C++).

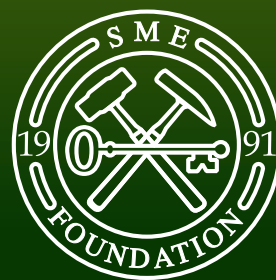
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Mine waste could help clean water; USGS report finds new uses for acid mine drainage sludge

THE U.S. Geological Survey (USGS) announced the findings from a study that found that a byproduct resulting from the treatment of acid mine drainage may have a second life in helping clean waters coming from agricultural and waste water discharges. The study was conducted by scientists from the USGS Leetown Science Center.

The report, published in the journal *Water, Air, and Soil Pollution*, shows that dried acid mine drainage sludge, or residuals, that result from treating acid mine drainage discharges, can be used as a low-cost adsorbent elsewhere to efficiently remove phosphorus from agricultural and municipal waste waters. The phosphorus that has been adsorbed by the mine drainage residuals can later be stripped from the residuals and recycled into fertilizer. The mine drainage residuals can be regenerated and reused for a number of additional treatment cycles. Application of this novel, patented technology has the potential to simultaneously help to decrease acid mine drainage treatment costs, prevent degradation of aquatic ecosystems and recycle valuable nutrients, the USGS said in a release posted on its website.

"This wonderful result shows the inventive application of some very sophisticated environmental chemistry to create a new life cycle for what otherwise would have been some problematic waste products," said USGS Director Marcia McNutt. "It sets the bar high for future studies in environmental remediation."

Acid mine drainage is produced whenever sulfide minerals associated with coal and metal deposits are exposed to air and moisture. The resulting acid and dissolved metals are toxic to most forms of aquatic life. Untreated acid mine drainage has impacted more than 8,000 km (5,000 miles) of streams in the Appalachian region, with associated economic impacts of millions of lost dollars in the tourism and sport fishing industries.

When acid mine drainage is remediated, it is neutralized with a base, such as limestone or lime, and an iron-rich sludge is formed that must be disposed of, sometimes at considerable cost. The new process of using the sludge to filter waste water has the potential to reduce the need to dispose of the sludge, while providing an added and previously unknown benefit of using the residuals to effectively reduce phosphorus from waste water discharges wherever needed.

Excess phosphorus released to the environment from agricultural and municipal waste waters has resulted in significant impairment of aquatic ecosystems, such as the Chesapeake Bay and other bodies of water worldwide. At the same time, as depletion of high-grade phosphorus-bearing deposits continues, the possibility of future shortages of fertilizer phosphorus has been suggested.

Current technology for the removal of phosphorus from waste water consists of the addition of aluminum or iron salts to precipitate and adsorb phosphorus. But this is too expensive for the low concentrations and high volumes often encountered in many waste waters. This new technology provides a more efficient and cost-effective option.

"As environmental scientists, we kind of hesitate to use this analogy, but it really is like killing two birds with one stone," said Philip Sibrell, lead author of the study. "This new technology could reduce or eliminate the need to dispose of acid mine drainage sludge, instead making that same sludge useful in addressing the urgent need to reduce the amount of phosphorus going into aquatic ecosystems; it's a win-win situation."

Study citation: Sibrell, P. L. and Tucker, T. W., 2012, "Fixed bed sorption of phosphorus from wastewater using iron oxide-based media derived from acid mine drainage," *Water, Air and Soil Pollution*, 223:5105-5117. ■

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DOE to set up Energy Innovation Hub; Ames Laboratory will establish Critical Materials Institute

THE U.S. Department of Energy (DOE) announced that a team led by Ames Laboratory in Ames, IA, has been selected for an award of up to \$120 million over five years to establish an Energy Innovation Hub that will

develop solutions to the domestic shortages of rare earth metals and other materials critical for U.S. energy security. The new research center, which will be named the Critical Materials Institute (CMI), will bring

together leading researchers from academia and four DOE national laboratories, as well as the private sector.

The new hub will focus on technologies to make better use of the materials available, as well as eliminate the need for materials that are subject to supply disruptions.

These critical materials, including many rare earth elements, are essential for American competitiveness in the clean energy industry. Many materials deemed critical by the DOE are used in modern clean energy technologies. The DOE's 2011 *Critical Materials Strategy* reported that supply challenges for five rare earth metals (dysprosium, terbium, europium, neodymium and yttrium) may affect clean energy technology deployment in the coming years.

CMI will leverage these existing research programs into a larger, coordinated effort designed to eliminate materials criticality as an impediment to the commercialization of clean energy technologies. The hub will address challenges across the entire life cycle of these materials.

CMI, headquartered at Ames Laboratory, will be directed by Alex King, currently the director of Ames Lab. The hub will bring together some of the most advanced critical material research programs in the U.S. today. Other national labs partnering with Ames include Idaho National Laboratory, Lawrence Livermore National Laboratory and Oak Ridge National Laboratory. University and research partners include Brown University, the Colorado School of Mines, Purdue University, Rutgers University, University of California-Davis, Iowa State University and Florida Industrial and Phosphate Research Institute. Industry partners that have joined to help advance CMI developed technologies include General Electric; OLI Systems, Inc.; SpinTek Filtration, Inc.; Advanced Recovery; Cytec, Inc.; Molycorp, Inc. and Simbol Materials. ■



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Mining bill a top priority in Wisconsin; Governor pushes for bill that will pave the way for iron ore project

EFFORTS TO PASS a mining bill that failed to win support from Wisconsin lawmakers last year will be renewed in 2013, as Republican lawmakers and Wisconsin Gov. Scott Walker have made the bill a top priority.

At the heart of the bill is a mining operation in northern Wisconsin that supporters say will bring hundreds of new jobs, but failed to win support last year because of environmental concerns.

Walker stopped in Green Bay, Schofield and Milwaukee on Jan. 2 in an effort to gather support for the measure in the 2013-2014 legislative session. The bill was in draft stages, but should include only “a few tweaks” to distinguish it from last year’s Assembly bill, he said at Valley Plating and Fabricating in Green Bay.

Meanwhile, in Madison, Assembly Republican leaders said the first bill they will introduce this session

will reform Wisconsin’s mining laws, *Gannett Wisconsin Media* reported.

Speaker Robin Vos and Majority Leader Scott Suder released a statement calling the bill a top priority. They said the measure will help create thousands of jobs but didn’t offer any details on what changes the bill might make.

Florida-based Goebic Taconite has been working with Republicans to open an iron mine south of Lake Superior. Company officials say the mine would create 700 jobs in the economically depressed region and Republican legislators are aiming to ease the regulatory path.

“Folks from outside of the state were trying to shut down (the bill) due to the politics of the recall,” Walker said Wednesday. “The environmental provisions had next to nothing to do with the passage of the bill. I think it was entirely politics. Fourteen senators were under tremendous pressure from

Washington, D.C., forces not to pass legislation that would relate to jobs.”

With a GOP majority in both houses of the Legislature, Republicans should be able to push the legislation through.

Walker and Sen. Dave Hansen (D-Green Bay), both acknowledge a tradition of mining in the state, but Hansen said bringing the company to Wisconsin is not an “overnight solution” to the jobs situation in the state. Hansen said it will take several years before construction will begin on the mine.

Assembly Minority Leader Peter Barca (D-Kenosha), said in a statement that a bipartisan mining bill is an “important” priority for this session.

“We need to make sure the bill creates mining jobs and also protects our natural resources, as well as our tourism and agricultural economies that are so vital to Wisconsin,” said Barca. ■

SEC: Payment disclosure rule challenged

(Continued from page 10)

the public disclosure of the payment information, now advance a series of meritless challenges,” the SEC said.

The lawsuit is one of a string of legal challenges against regulators still struggling to finalize dozens of rules included in Dodd-Frank and other recent financial regulatory reforms.

The SEC and the Commodity Futures Trading Commission (CFTC) have lost a handful of such challenges, often over whether the agencies adequately considered a rule’s costs and benefits.

In December, a federal judge upheld a new CFTC rule governing certain mutual funds, but that ruling is currently on appeal.

The SEC’s transparency rule at issue was designed to build on voluntary initiatives by mandating

disclosure of payments to foreign governments made by companies in so-called “extractive industries” whose shares trade on U.S. exchanges.

Though controversial, the law’s congressional sponsors said it would help citizens hold resource-rich governments accountable for their management of resource revenues.

The business groups that brought the lawsuit had asked the SEC to confidentially collect the information and release it only on an aggregate, by-country basis, to protect individual companies.

In their lawsuit, they said such a model was consistent with the statute. The SEC said the law shows Congress intended for public disclosure of each company’s individual information.

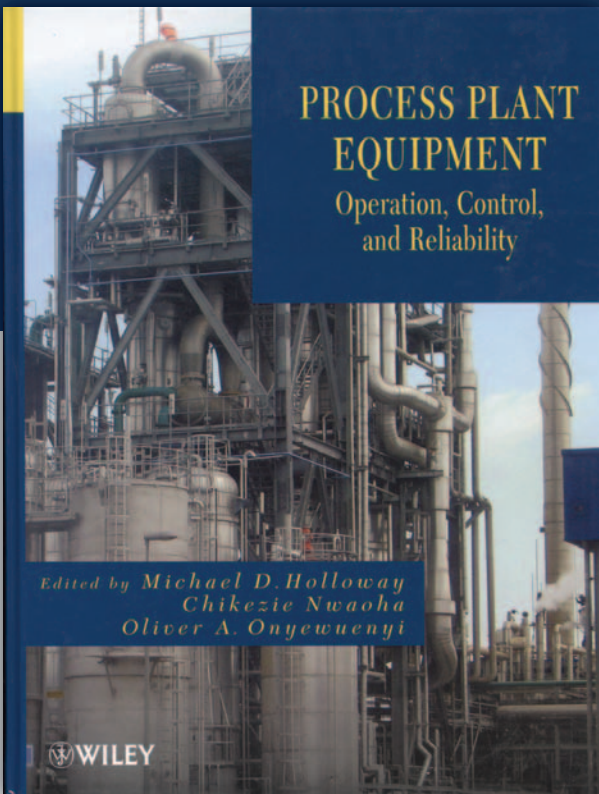
The SEC also responded to the cost-benefit argument, and said it was

dependent on data provided by the industry to assess the costs. It said it could not quantify the rule’s potential benefits of enhanced governmental accountability.

The groups had also argued that the rule violated the First Amendment, which the SEC described as an “eleventh-hour shift in strategy,” because the groups’ other arguments lacked merit.

That strategy ignores that regulated companies are subject to many other public reporting requirements, and such a theory could have “potentially devastating implications” for the other programs, the SEC said.

The agency asked the court to schedule a hearing in the case after mid-February due to scheduling conflicts. ■



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Throughout the book, numerous photos and diagrams illustrate the operation and control of key process equipment. There are also case studies demonstrating how actual process plants have implemented the tools and techniques discussed in the book. At the end of each chapter, an extensive list of references enables readers to explore each individual topic in greater depth.

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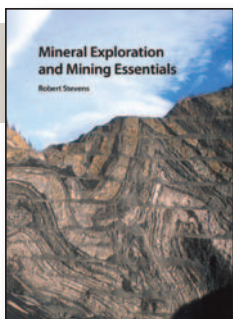
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Ontario remains mining hotbed;

Favorable legislation and Ring of Fire offer promising future

by Steve Kral, Editor



Scaling work at Lake Shore Gold's Bell Creek Mine in Sudbury, Ontario. Photos courtesy of the Ontario Ministry of Northern Development and Mines.

Mining is big business in Ontario. The province is Canada's leading mining region. It consistently ranks among the top 10 jurisdictions worldwide for exploration spending, reaching about C\$1 billion in 2011. More than 26 percent of all exploration and appraisal dollars spent in Canada are invested in Ontario.

Minerals produced include nickel, copper, platinum group elements (PGE), cobalt, zinc, diamonds, gold and silver. It was reported that there are more than 600 mining exploration projects in the province. And, recent discoveries of chromite in northern Ontario's Ring of Fire will add to the province's mineral production in the coming years.

In 2011, capital investment in Ontario's mining industry reached about \$3.5 billion, more than any other province. In 2012, that was expected to increase to nearly \$3.8 billion.

Representatives from the Ontario Ministry of Northern Development and Mines (OMNDM) said during an October visit by the mining media that Ontario accounted for about 21 percent of Canada's nonfuel mineral production during 2011, valued at about \$10.7 billion. The mining industry employs about 27,000 direct jobs and an additional 50,000 indirect jobs in the province. Average weekly wages are about \$1,500, among the highest of any industrial sector. And the Ontario mining industry spends more than \$1

billion a year in goods and services. About 45 percent of this is spent near the mines, while the rest is spent within the entire province.

The OMNDM also said that about 45 percent of suppliers, about 500 companies, to Canada's mining industry are located in Ontario. These companies are estimated by the Ontario government to generate about \$5.6 billion a year.

There are currently 42 active mines in Ontario, and another eight are committed to be operational in the next 10 years. Goldcorp has started a large expansion program at its Red Lake, Timmins and Musselwhite operations. These expansions are expected to double current output. Detour Gold's \$1.5-billion Detour Lake project is expected to begin production in 2013, producing about 20.2 t/a (650,000 oz/year) of gold.

Meanwhile, Cliffs Natural Resources and Noront Resources are in predevelopment of chromium, nickel, copper and PGE deposits in the Ring of Fire region. Cliffs is also considering the construction of a ferrochrome smelter in Ontario.

Legislation, tax regime

The Ontario government has for several years been working to modernize its mining laws. According to the OMNDM, the provincial government is aware of the geopolitical risks and high level of uncertainty associated with mining projects. So, in rewriting the mining act, the government has tried to ensure that any new law would maintain a favorable investment climate and lessen geopolitical risk. Changes to the law, announced in October 2012, are aimed at continuing the balance between mineral exploration and development and social and environmental responsibility.

Ontario believes it has one of the most competitive tax regimes for exploration and development. Focused flow-through shares can reduce the after-tax cost of \$1,000 to \$432, the ministry said. In 2010, the province eliminated the capital tax. And the government instituted a 10-year mining tax exemption and a reduced tax rate for new remote mines.



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In addition to updated legislation and a more favorable tax regime for mining projects, the province also instituted a “one window approach” to mineral development. This involves the appointment of a Mineral Development Officer to guide companies through the permitting process. This person works with companies, government agencies, First Nations and communities that will be affected by a mine to expedite the permitting and mine development process.

Ring of Fire

In Ontario’s Far North is a region that holds huge mineral potential. Several significant discoveries have been made in the Ring of Fire region (named for the Johnny Cash song, not anything geologic). The Ontario government said the region holds significant deposits of chromite, copper, zinc, gold and kimberlite.

Twenty-three companies currently hold claims in the area. All activity in the Ring of Fire is still in the exploration stage. Exploration expenditures have so far reached about \$278 million.

While the region is poised to explode in mine development, the Ring of Fire currently

lacks the necessary infrastructure to further development. However, the province is working with mining companies, local communities and governments, and First Nations to proceed with developing the region’s infrastructure, including all-weather roads and, possibly, a rail line.

Cliffs Natural Resources and Noront Resources are both advancing several proposed projects through feasibility and environmental assessment. Cliffs’ plans are for an openpit chromite mine. Development of this project will include an all-weather road and a value-added ferrochrome refinery. The company’s investment potential is estimated to be about \$3.3 billion.

Noront Resources is studying an underground nickel mine and concentrator, along with underground tailings storage and an all-weather road. Capital investment in the proposed project is estimated to be \$609 million.

KWG, another large company with interests in the Ring of Fire, has staked several claims with the goal of developing a chromite mine. The company has proceeded with an engineering program to possibly build a railroad from Exton to the Trans Canada rail line.

Lake Shore Gold

Timmins is a city in northern Ontario that was built on mining, mostly gold mining. Mines in the area are estimated to have produced about 2.17 kt (70 million oz) of gold since gold mining began. The region has also produced significant amounts of copper and nickel.

Lake Shore Gold operates three gold mines in the area — Timmins West, Fen-Gib and Bell Creek. The company also has a large number of exploration targets in the Timmins region that will keep the mines operating for several decades. Lake Shore Gold’s current gold holdings amount to about 105.7 t (3.4 million oz) measured and indicated and another 115 t (3.7 million oz) inferred.

Bell Creek is North Shore Gold’s newest mine. Located east of Timmins, this underground mine has been in operation since January 2012. Gold production from the mine was expected to be about 622 kg (20,000 oz) during 2012, with plans to increase that in 2013.

Lake Shore Gold’s processing facilities are also located at the Bell Creek site. In 2011, the company increased the mill throughput for all three mines to 2.1 kt/d (2,300 stpd)

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Lakeshore Gold Corporation's Bell Creek Gold Mine in Timmins Ontario.

from 1.7 kt/d (1,870 stpd). Since then, Lake Shore Gold has embarked on a \$100-million mill expansion that should reach 3 kt/d (3,300 stpd) during 2013 and eventually reach 5.5 kt/d (6,000 stpd). Included in the expansion are new crushers, a semiautogenous grinding mill and a dome.

Lake Shore Gold recently announced that its full-year gold production from its mines in 2012 was on target. And it expects to increase production in 2013. Production from the Timmins West Mine was 2.66 t (85,782 oz) from 719.3 kt (793,000 st) of ore at an average grade of 3.9 g/t (0.12 oz/st).

In 2013, Lake Shore Gold expects production to increase to between 3.7 to 4.2 t (120,000 and 135,000 oz) of gold at cash costs of between \$25.70 and \$27.30/g (\$800 and \$850/oz). The company budgeted \$80 million in capital spending for 2013, along with \$10 million in exploration spending.

Vendors/suppliers

Ontario's robust mining industry and the provincial government's efforts to increase its natural resource development sector have resulted in a large number of vendors, consultants, research entities and equipment suppliers. These companies not only market their products and services to the Ontario mining industry, but they also help supply the rest of Canada's industry. And many operate internationally.

The Ontario North Economic Development Corp. released a study that found mining supply and service-company output in the province is valued at about \$5.6 billion. Services offered include mining engineering and mine management; mining equipment manufacturing; customization of wheeled, tracked and flanged vehicles; equipment repair and rebuild; and support in the form of consulting, research, training and financing.

Mining Technologies International (MTI). In 2009, MTI began work on a test tunnel in Sudbury, Ontario that would allow the mining equipment maker to demonstrate its products to potential customers. The company manufactures and tests hydraulic drill jumbos, LHD loaders, dump trucks, shaft drilling jumbos, long hole jumbos, in-the-hole (ITH) drilling rigs, computerized drill rigs, automated ITH drills with rod handlers, rail haulage systems (chutes, rail cars and dump stations), mine locomotives, buckets, bucket lip assemblies, bucket wear parts and low profile crushing plants, as well as custom-designed equipment for specific underground requirements.

The 5-x-5-m- (16-x-16-ft-) diameter tunnel is currently about 400 m (1,300 ft) long with a 15-percent incline. The tunnel is not yet complete, but the company expects it to become a mature test tunnel in about a year. In the meantime, the project is far enough along that MTI can proceed with product development, testing and research.

The test tunnel has several uses for MTI. Its three primary functions are in product development, product testing and product precommissioning. As new technology is added to a piece of equipment, the tunnel allows MTI

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personnel and customers to test it in a mine-like environment. Company personnel can also get valuable feedback from operators.

MTI also works with local research organizations to develop new technologies for the mining industry. Training has also become a part of MTI's program. The company works with contractors and mining companies to train their personnel on various pieces of equipment, including a shaft sinking training center. And two local colleges are working with MTI to provide engineering students with hands-on experience in surveying and ventilation.

Rail-Veyor. Low commodity prices a few years ago caused Vale to halt production at the 114 orebody at its Copper Cliff North Mine in Sudbury. This gave the company an opportunity to test Rail-Veyor's material haulage system, with the goal of increasing production at Copper Cliff North and other Vale mines.

The Rail-Veyor system combines the technologies of heavy-rail haulage, overland conveyors and truck haulage. Two-wheel cars mounted on light rail track can move material over short and medium distances over a variety of terrain. The system can move up to 8 m/sec (26 ft/second) at grades of up to 20 percent.

The Rail-Veyor system at Copper Cliff North is designed to advance mine development at about 122 m/week (400 ft/week), up from Vale's planned 61 m/week (200 ft/week). This material haulage system could allow the mine to increase production to 2.5 kt/d (2,750 stpd) from 1.25 kt/d (1,380 stpd), and eventually up to 4 kt/d (4,400 stpd). ■

TMAC gets Hope Bay; Company signs letter with Newmont

WITH THE INTENT to focus on projects that are closer to producing gold ore, Newmont Mining Corp. said it had signed a letter of intent to sell its stalled Hope Bay gold-mining project in the Canadian Arctic to TMAC Resources Inc.

Terms of the proposed transaction, which Newmont said would follow an acquisition agreement and "equity financing," were not released and a press release did not elaborate on the nature of the equity financing.

Newmont placed the Hope Bay development on hold in 2012 and took a \$1.6-billion write-down during the fourth quarter of 2011.

Newmont, the world's second-largest gold-mining company by production, acquired the Hope Bay development in 2007 through its \$1.5-billion acquisition of Miramar Mining Corp.

TMAC is "the right partner to improve prospects for near-term development of the Hope Bay Project," Randy Engel, executive vice president of Strategic Development for Newmont, said. "We look forward to developing a strong, long-term partnership as a significant shareholder of TMAC."

Engel did not say what involvement Newmont might have after the transaction.

"There have been, for some time, a variety of parties interested in Hope Bay," Newmont spokesman Omar Jabara told *Dow Jones Newswires*. "We know there's gold there, it's just a question of what's the right option for developing the gold."

"We believe the Hope Bay Belt has great potential to be Canada's next major gold-mining camp and a long-term, profitable and environmentally responsible gold producer for the benefit of all stakeholders," Terry MacGibbon, TMAC's executive chairman said. ■

BC court rules with First Nations; Claim staking decision could have ramifications for mining industry

THE BRITISH Columbia Court of Appeals delivered a ruling in favor of the Ross River Dean Council (RRDC) that could have far-reaching ramifications for the mining industry.

The court ruled that allowing claims staking without first consulting First Nations is a break of the Crown's duty to consult, *Canada News Wire* reported.

The government and industry now have the choice of spending huge sums and possibly several years trying to fight this decision before the Supreme Court of Canada, where First Nations have a winning record, or sit down with First Nations to finally come up with a better way of doing business, said the BC First Nations Energy and Mining Council (FNEMC).

The ruling has huge national ramifications and is most immediately

and directly applicable to the BC system – on which the Yukon system is based. The decision was delivered Dec. 27 by three justices from the BC Court of Appeals sitting in Whitehorse.

"This decision will eventually result in significant reforms to the mining industry across British Columbia," said FNEMC Board Director Chief Roland Willson. "For the first time in a mining case, the Courts have said the duty to consult and accommodate must take place prior to the granting of an exploration interest, including the commencement of activities."

FNEMC CEO, Dave Porter said: "For decades, the claims process has been at the root of mining confrontation in BC and, with this ruling, it is in no one's interest to delay reform any longer with further costly and lengthy court battles that

in all likelihood will only delay the inevitable while continuing to deter investors from BC.

"It is imperative that the BC government engage now with First Nations to develop an alternative process to free entry, and we extend an invitation to industry to work with our Council to develop options for consideration by the chiefs," said Porter.

The FNEMC noted that the Yukon ruling comes at a time when investors are raising concerns about the huge sums being lost on failed mining proposals that are opposed by First Nations, international mining executives are raising concerns about the failure to address First Nations issues, major mining companies are curtailing growth plans and junior mining companies are finding it extremely difficult to raise capital. ■

Openpit research chair to be in Sudbury

CANADIAN GOLD mining company Iamgold will fund a new research chair position in openpit mining at the Bharti School of Engineering at Laurentian University in Sudbury, ON.

The Bharti School of Engineering at Laurentian University is creating the position with a \$1.25-million investment from Toronto-based Iamgold Corp.

"This investment represents a critically important enhancement of our research capacity at the Bharti School," said Ramesh Subramanian, the school's director.

"This new research chair will attract more cutting-edge knowledge to our mining engineering programs and will certainly augment our international reputation in mining."

Laurentian said it hopes to have a candidate in place by July of this year.

"The future of the mining industry depends on our ability to step up the pace of innovation and this has to start with educational programs and research opportunities specializing in advanced mining techniques," said Steve Letwin, Iamgold's president and chief executive officer. ■

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First Quantum gets hostile in bid; Takeover offer for Inmet Mining jumps to C\$5.1 billion

AFTER BEING rejected with its first offer, First Quantum has returned with an improved C\$5.1 billion (US\$5.2 billion) takeover offer for rival Inmet Mining.

First Quantum, which operates mines from Zambia to Australia, said that it had offered Inmet Mining's shareholders a cash-and-stock deal valued at a \$72.87 for each share in the Canadian copper miner.

The renewed bid for Inmet Mining represents a slight increase from a previously rejected \$70.85-a-share takeover approach for the copper producer and a 36 percent premium on the mining company's closing share price before it rejected First Quantum's initial advances, *The New York Times* reported.

Inmet Mining's board had rebuffed an earlier offer in late November

valued at \$63.26-a-share.

First Quantum, which is based in Vancouver, BC, said the proposed deal would create one of the world's leading copper producers that could produce around 1.3 Mt/a (1.4 million stpy) of copper by 2018.

The mining company said it had taken its takeover approach directly to Inmet Mining's shareholders and called on the company's board to reconsider its multibillion-dollar offer. First Quantum added that it had held discussions with a number of Inmet Mining's key investors about the proposed deal. The company did not say which investors it had contacted.

"We believe strongly in the prospects of a combination for our two companies," First Quantum's chief executive, Philip Pascall, said in a statement. "Our clear preference

remains to engage with Inmet, as we believe strongly in the compelling strategic and financial merit of the transaction."

Despite concerns that a downturn in Asian economies could hurt short-term demand, companies are seeking to gain access to metals and minerals in expectation that fast-growing economies will soon rebound.

Inmet Mining, which is based in Toronto, owns the Cobre Panama copper project, one of the world's largest remaining untapped deposits of the metal. The mining company expects to spend more than \$6 billion to develop the site and recently announced a 27 percent increase in the project's copper deposits. First Quantum said that it would fund the takeover through its cash reserves and \$2.5 billion of bank credit. ■

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Exploration company teams with Atlas Copco for stealth rig for sensitive ecologies

Energold Drilling Corp. is a leading specialty drilling company servicing the mineral and energy sectors in the Americas, Africa and Asia. Energold specializes in mineral exploration in remote locations with limited infrastructure. Such locations require the smallest footprint possible going in, leaving as little or no evidence on their way out.

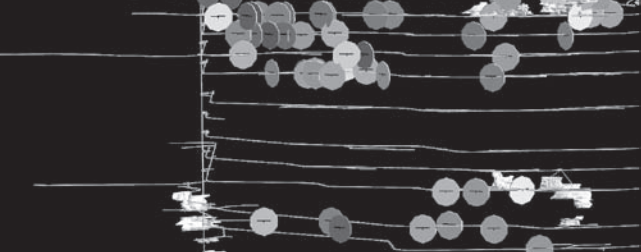
Energold's rigs can be transported by helicopter or manually on footpaths as narrow as 1 m (3.3 ft). They set up quickly and then are struck and packed out, with any sign of their presence quickly disappearing behind them. Energold has teamed up with Atlas Copco and its team of engineers in North Bay, Ontario to design small rigs capable of drilling to a variety of depths, as required for each project.

Robert Neil is the product manager for Atlas Copco Canada's exploration drilling lines. When he learned of Energold's requirements, the Atlas Copco CS1000 P4 came to mind right away. At only 3,175 kg (7,000 lbs) wet fly-in weight, the CS1000 P4 was already one of the most portable



of all commercially manufactured exploration rigs. In the PQ and HQ sizes that Energold will typically drill with the rig, it can go to 305 and 460 m (1,000 and 1,500 ft), respectively. However, in BQ, it will go as deep as 1,070 m (3,510 ft). Its

The CS1000 P4 is shown at work for Energold in Guinea, West Africa.



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Neil knew right away that the P4, an industry-proven design, could achieve the depths Energold was intending to reach. "Our thoughts were to provide a custom trailer, based on the stock item, which could be divided into four modules that met the weight and size requirements," Neil said.

Exploring the globe

Based in Vancouver, Energold is a fast-growing company, earning recognition as one of Canada's fastest growing companies in 2009, 2010 and 2011 by *Profit Magazine* and placed in *Business in Vancouver's* Top 100 Fastest Growing companies four times. Just six years after its incorporation, Energold expanded from six rigs to 230 rigs, operating in 22 countries. The company has also recently diversified through several corporate acquisitions to provide customers with mineral drilling, oil sands drilling, water well drilling and drill rig-manufacturing services.

The company's reputation has not been built solely upon its award-winning environmentally sensitive operations. It has gained attention for its dedication to social responsibility. The company has donated water wells and has helped build roads and bridges. Energold is socially responsible, with a corporate policy to hire local laborers as drillers' helpers, with the opportunity to advance their skills to become helpers and, eventually, experienced drillers and drill supervisors.

Ryan Davidson, Energold Operations, said one of the greatest decision factors in working with Atlas Copco was timely response. When Energold solicited bids from manufacturers for a research and design project, Atlas Copco responded within the hour and continued the dialog periodically throughout the day with calls and emails. Davidson said other companies took two or more days to respond.

Ken Breen, Atlas Copco sales representative to British Columbia, invited Energold executives to meet the engineers at North Bay and to see the facilities firsthand. That kind of attention sold Energold on Atlas Copco's commitment to work with them.

Customer-led design

Neil said, "Using the stock CS1000 P4 rig as a base, a number of personnel from Energold and Atlas Copco consulted on a regular basis over a six-month period to define the exact weights and dimensions that could be economically achieved."

Once they agreed upon its design parameters, the concept was sent for engineering approvals.

Neil explained that Energold personnel and a client's safety consultant visited the North Bay factory to view the stock rig and share ideas on technical issues that may arise in the application of the finished product. Design changes emerging from those visits were incorporated into the working drawings.

Once satisfied with the proposal, a prototype was built. The result was a new four-part modular CS1000 P4 design. A custom modular trailer was fabricated and all major components were transferred from a stock rig with some modifications made to assist with the disassembly, transport and reassembly of the rig in the field.

Neil said the project did present some challenges for Atlas Copco. "Numerous safety features were added to the rig due to site safety requirements. These upgrades had to be reviewed at the North Bay factory by representatives of Atlas Copco, Energold and the consultant for the client, at whose site the rig would be operating. Some of the required safety items were not common to the drilling industry and had to be designed and implemented as the project progressed." These included such items as a hydraulic valve interlock system to prevent chuck rotation whenever the feed guard is open, as well as extra guarding around the hoists, engine, hydraulic tank, mud mixer and rod holder to conform to Energold's and its client's specifications.

The first four of these rigs, which went to West Africa on a mineral exploration contract, have been drilling typically with PQ and HQ sized bits of various manufacturers to a depth of between 300 and 350 m (984 and 1,148 ft). Davidson said ground conditions have been "very tough," so the Guinea contract "has had above average drill bit usage and slow drilling with a lot of downtime due to client regulations." In consideration of these things, he believed the Guinea project was unlike their typical contracts to be a fair example of what the drilling rigs can do in penetration rate and drill-meters. Energold has seen more than 2,500 m/m (8,202 ft/month) from one of its CS1000 rigs.

They have not needed to break the rig into its components on this contract. However, Energold had several clients interested in the rig right away with the promise of many more orders in the future. The four-part modular version of the CS1000 P4 that Energold helped design is already proving to be a hit in Guinea. With the ever increasing demand for Energold's services, this new rig should prove to be a grand slam for Atlas Copco's exploration offerings in this burgeoning specialty market. ■



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Miners get defensive at 2012 Northwest Mining Association meeting

by Emily Wortman-Wunder, Technical Editor



**Keynote speaker
Michael Silver,
president and
CEO of American
Elements.**

Smart defense: that's what the industry needs to play for the next four years, according to panelists at the 118th Annual Meeting of the Northwest Mining Association (NWMA), which met December 2-7 in Spokane, WA. The conference was well attended, with approximately 2,200 attendees, 244 booths in the two packed exhibition halls, and a rich offering of short courses, field trips, social events and technical sessions.

Speakers at the packed legislative session articulated many of the frustrations felt by members of the mining community after the U.S. elections in November, and offered words of advice. Matthew Ellsworth, the new Government Affairs hire at NWMA, stated it best: "Elections are like Christmas: you find out who's naughty and nice – and it's always going to come again."

Ellsworth agreed that the mining industry has a difficult four years ahead, legislatively, but reminded the crowd that mining has a good story to tell, although it could sometimes tell that story better.

The need to tell mining's story more effectively was a theme of the meeting. From technical sessions to short courses and a keynote address, the same message kept popping up.

"You've got to have a ground game," said Kathy Benedetto, staffer on the House Natural Resources Committee and the Energy & Minerals Subcommittee. "Environmentalists have

a full communications and advertising plan that they implement two years in advance."

Michael Silver, president and chief executive officer of American Elements, gave the keynote address at the Welcoming Luncheon, analyzing the dangers of current U.S. government policy toward mining and concluding that the best way to improve public policy is to improve public attitudes toward mining – a job that falls first to the mining industry.

American Elements is a manufacturer of engineered and advanced materials, including several materials made with rare earths. This has put Silver at the front lines of the struggle over rare earths availability: he has been able to see firsthand the effect of U.S. policies, as well as the effect of Chinese policies, since China

has the bulk of the rare earth deposits currently being mined.

Silver said that the issue of control is critical: if a country has 50 percent of a global resource, it will be able to control that resource's pricing and distribution. He reminded luncheon attendees of OPEC and the 1970s oil crisis. Even though the OPEC countries didn't control all of the world's oil resources, they controlled enough to dictate price and availability.

That's why, Silver said, former Chinese ruler Deng Xiaoping said in 1987 that "the Middle East has oil, but China has rare earth." Furthermore, Silver pointed out, unlike the Middle East, China is so big that it makes its own market – it doesn't need the rest of the world to buy its resource. Here's where the U.S. needs to be careful, Silver claimed: it is letting China make all the moves first, and opening itself to a new kind of vulnerability.

"What is a colony?" Silver asked. "A colony is a place that provides the raw material to a country, which develops the material into products that it then sells back to the colony." If the U.S. gets into a position where it sells most of its raw material to China, and then also buys most of its commodity goods from China, it could be entering a relationship in which China is the colonizer and the U.S. is the colony, with China dictating the price and distribution of U.S. natural resources.

Stepping back from this claim a little, Silver concluded by saying that China is doing everything right, from shepherding and safeguarding its own resources to staking out territory around the globe. The U.S., in contrast, “needs to get in the game.” He listed several culprits, from excessive regulation of the industry, to a weak vision for the country’s mineral resources policy, to mineral resource budget cuts at federal, state and local levels.

Finally, he said, one of the most important things the mining and metals industry needs to do is fight back against its negative image and get smarter with PR – not merely for its own sake, but for the sake of the national economy. Some of his suggestions included making friends with Hollywood, so that more movies showcase the cool, Indiana Jones aspects of mining, and fewer movies are like *Avatar*. The mining industry should reach out to young people and “educate, educate, educate.” Finally, Silver said, the industry should make friends with environmentalists by recognizing that their concerns are legitimate. “Let them know how other countries run their mining operations – environmentalists should be demanding that mining occur in the U.S.” And, Silver said, bringing his talk back to rare earths and how they are going to make or break mining, the industry should help environmentalists realize that an anti-mining stance is preventing the development of the high-tech, hydrocarbon-based future most environmentalists want.

Timothy Wood, executive director of the Denver Gold Group, gave the keynote address at the Industry Outlook Luncheon. Wood, a well-known mining media entrepreneur, spoke about the gold bull market and where it is likely to go now that gold has nearly reached prices of \$64.30/g (\$2,000/oz).

Technical sessions at Northwest Mining offered annual updates on the state of mining around the Northwest, equipment, methodology and finance. Several sessions touched on topics of current critical interest to the mining community, including rare earths, health and safety, and permitting.

One entire technical panel was devoted to the management complexities of the recent listing of the sage grouse as a candidate for protection under the U.S. Endangered Species Act, with panelists struggling to stay optimistic in the face of what feels like an increasingly hostile environment for mining. Murmurings elsewhere were less sanguine: “If you’re not a miner or a farmer, you’re not creating wealth,” snapped one audience member at the Newmont Director of Environmental Stewardship, “and I want to know: Are you part of the solution or are you



part of the problem?”

Alan Coyner, an administrator with the Nevada Division of Minerals, was even less favorable: sage grouse, he said, have the potential to make 6.7 million ha (15 million acres) off limits to mining in Nevada – in a part of the state that has been typically so favorable to mining that it has helped Nevada become one of the top 10 mining-favorable locations in the world, according to the Fraser Institute rankings.

As always, the prevailing mood about mining varies by state, with Washington, Oregon and Montana reporting declining production, revenue and exploration and Colorado, Utah, Nevada, Alaska and Idaho holding steady. Even for the healthiest mining markets, however, 2012 was a slow year, marred by unstable markets, dried up funding and a general wait-and-see attitude from industry as the outcome of the U.S. election remained in doubt. Even western Canada, where mining activity doubled in some provinces in 2011, found that the lack of funding and a few bad weather events in 2012 made for a slower year.

Certain trends emerged across the region — uranium projects, for example, were generally stalled, awaiting increases in the per pound price of uranium. Gold projects and gold exploration were generally robust, with a slight recent bump in mom-and-pop placer operations likely due, was the prevailing speculation, to the Discovery Channel show, “Gold Rush.” Molybdenum operations across the region were dusting themselves off and doing well, with the opening of the Climax Mine in Colorado, the revival of the Mt. Hope project in Nevada and Kennecott building a molybdenum autoclave process facility in Utah. Industrial minerals, the “silent giant,” as Colorado Geological Survey senior minerals geologist Jim Burnell said, was still being impacted by the

SME Minerals Education Coalition manager Sharon Schonhaut speaks with a visitor; SME member and booth volunteer Valerie Wade looks on.

housing slump, although as industrial minerals revenue/ production numbers tend to reflect local conditions, results varied by area.

In addition to the technical sessions and keynote luncheons, as well as meeting up with old friends and colleagues, the NWMA meeting is about the awards. The 2012 awards included recognition for corporate excellence (the Platinum Award; given to the Hecla Mining Company for its commitment to the three pillars of sustainability and its outstanding support of NWMA); for Distinguished Service to the Minerals Industry (to Ron Parratt, executive director of Renaissance Gold Inc. for his status as one of the premier “ore finders” in the industry and his distinguished service to NWMA, SME and other professional organizations); for important contributions to NWMA (the NWMA President’s Award, awarded to Eric Williams, partner of Gallatin Public Affairs, and longtime service to NWMA, including serving as trustee, 1998 to 2001 and 2006 to 2008; second vice president, 2000, and chair of the Public Outreach

and Education Committee for several years; he was instrumental in developing NWMA’s The More You Dig website and educational campaign); for Environmental Excellence (to the Homestake Mining Company of California for advancing sustainable post-mining land use in the reclamation and closure of the Homestake Mine in Lead, SD). Awards also recognized safety in two awards, the NWMA’s Safety Award – Individual, to Ted Himbaugh for his work as manager of Kennecott Utah Copper Bingham Canyon Mine and creating a culture of safety there, and the NWMA’s Safety Award – Team, to the NIOSH Diesel Team for its outstanding work in reducing exposure of underground miners to emissions from diesel equipment. Finally, the NWMA recognized the Association of Mineral Exploration, British Columbia (AME BC) for its first 100 years supporting mineral exploration in British Columbia and throughout the world.

The 2013 Northwest Mining Association Conference will be held in Sparks, NV, Dec. 2-6 at the John Ascuaga’s Nugget Casino Resort. ■

Mining robot to be developed; Carnegie Mellon partners with Anglo American

Carnegie Mellon University (CMU) has signed a five-year master agreement with Anglo American PLC to develop robotic technologies for mining.

CMU’s Robotics Institute (RI), through its National Robotics Engineering Center (NREC) and Field Robotics Center (FRC), will design, build and deploy mining robots, robotic tools and autonomous technologies in partnership with Anglo American’s Technology Development Group.

“We are excited that Anglo American selected CMU as its partner for developing innovative mining robotics,” said Tony Stentz, NREC director.

“This agreement will break new ground in mining technology,” said Dimi Apostolopoulos, principal investigator and senior systems scientist at NREC. “We will apply robotics to underground mining tasks that are perilous and extremely challenging for humans. Our robotic solutions will improve productivity through innovations in processes and technologies.”

The RI will build upon its track record of successful mining automation projects to develop advanced perception, electromechanical and robotic systems for Anglo American. It will

partner with Anglo American engineers to put the NREC’s and FRC’s field-proven technologies to work in the company’s mining operations. The immediate applications include robotic mining machinery, mine mapping and automated inspections. Anglo American and the RI also will explore other applications under this master agreement.

Automating the most difficult, costly and dangerous mining jobs will improve safety and increase the productivity and efficiency of Anglo American’s operations. Advances in robotics will allow the mining of hard-to-reach ore deposits that cannot be economically extracted under existing methods and mine layouts.

Anglo American’s master agreement with CMU is part of its strategic plan for advancing mining technologies.

“Working with top robotics experts is essential to our technology and innovation programs,” said Donovan Waller, who leads automation and remote control technology development for Anglo American. “Our agreement with Carnegie Mellon University will allow us to rapidly deploy new systems in our platinum mines and develop technologies that will shape our future operations.” ■

Analyzing solutions of the openpit block sequencing problem obtained via Lagrangian techniques

by W.B. Lambert and A.M. Newman

Abstract ■ A common decision in openpit mining is to determine the extraction sequence of notional three-dimensional production blocks so as to maximize the net present value of the extracted orebody, while adhering to precedence and operational resource constraints. This *openpit block sequencing* (OPBS) problem is commonly formulated as an integer program, with binary variables representing if and when each block is extracted. In practical applications, the number of blocks can be large and the time horizon can be long; therefore, instances of this problem can be difficult to solve using the exact approach of optimization. The problem is even more challenging to solve when it includes explicit minimum operational resource constraints. Our maximum value feasible pit (MVFP) algorithm generates an initial integer feasible solution for OPBS problems, in which minimum operational resource constraints are strictly enforced. As an exact approach, we present a Tailored Lagrangian Relaxation (TLR), in which the selection of constraints to dualize is guided by information provided by the MVFP algorithm. We present results and graphics to demonstrate the utility of our techniques for instances containing up to 25,000 blocks and 10 time periods.

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Introduction

Mining is a risky business, in which scheduling the efficient extraction of material is critical to enhancing profitability. Firms seek an extraction sequence of three-dimensional production blocks that maximizes net present value (NPV), while satisfying geospatial requirements and operational resource limitations (e.g., maximum per-period

production capacity). Solving an optimization problem called the openpit block sequencing (OPBS) problem provides this sequence, specifying which blocks to remove, and when.

1. Our specification of the openpit block sequencing (OPBS) problem

Openpit mine scheduling problems range in scope from the strategic ultimate pit limit (UPL) problem, first efficiently solved by Lerchs and Grossmann (1965), to tactical, precedence-constrained production scheduling problems. This paper employs techniques to expedite solutions for the constrained pit limit problem (CPIT), the solution of which identifies those blocks to extract and when. Our specification of (CPIT) is a simplified version of the model first presented in Johnson (1968); we enforce geospatial and operational resource constraints. In the literature, many solution strategies for variants of (CPIT) (e.g., Moreno et al., 2010; Bienstock and Zuckerberg, 2010)

consider only maximum operational resource constraints (e.g., maximum production capacity). However, in openpit mining, it is not always practical to stop and restart production and processing operations. Therefore, our specification of (CPIT) supplements these maximum operational resource capacities with positive minimum operational resource requirements.

2. Models

The techniques we present rely on two mathematical formulations: (i) the ultimate pit limit problem (UPIT) from the seminal work of Lerchs and Grossmann (1965), and (ii) the constrained pit limit (CPIT) problem, as in Espinoza et al. (to appear). Our mathematical notation for, and formulations of, these two problems follow.

Sets, indices, data and decision variables:

- $b \in B$: set of all blocks b
- $b' \in B_b$: set of blocks which

W.B. Lambert, member SME, and A.M. Newman are PhD and associate professor in the Division of Economics and Business, Colorado School of Mines, Golden, CO. Email wlambert@mines.edu and anewman@mines.edu. Paper number TP-12-007. Original manuscript submitted February 2012. Revised manuscript accepted for publication September 2012. Discussion of this peer-reviewed and approved paper is invited and must be submitted to SME Publications by Mar. 31, 2013.

must be extracted directly before block b ; i.e., b 's direct predecessors

- $t \in T$: set of time periods t
- $r \in R$: set of operational resources r (1 = production, 2 = processing)
- τ : length of time horizon; i.e., $\tau \equiv |T|$
- v_b : net value of extracting block b (\$)
- v_{bt} : net present value of extracting block b in time period t (\$)
- a_{rb} : amount of operational resource r required for block b (tons)
- $\underline{e}_r / \bar{e}_r$: per period minimum required usage / maximum usage capacity for operational resource r (tons)
- y_b : 1 if block b is extracted, 0 otherwise
- w_{bt} : 1 if block b is extracted by time t , 0 otherwise

The network-based (*UPIT*) formulation is the classical ultimate pit limit problem, the solution of which is the highest-valued subset of blocks satisfying precedence constraints.

(UPIT) formulation:

$$(UPIT) \max \sum_{b \in B} v_b y_b \quad (1)$$

Subject to:

$$y_b \leq y_{b'} \quad \forall b \in B, b' \in B_b \quad (2)$$

$$0 \leq y_b \leq 1 \quad \forall b \in B \quad (3)$$

The objective function (1) maximizes the undiscounted value of all extracted blocks. Constraints (2) enforce block precedences and form a constraint matrix A with special structure, guaranteeing that decision variables in an optimal solution will assume integer values. Therefore, we need only restrict y_b to continuous values between 0 and 1, as in constraints (3).

Adding temporal fidelity to, and imposing resource limitations on, (*UPIT*) creates the constrained pit limit problem (*CPIT*), the solution of which identifies those blocks to extract and when (Espinoza et al., to appear).

(CPIT) formulation:

$$(CPIT) \max \sum_{b \in B} \sum_{t \in T} v_{bt} (w_{bt} - w_{b,t-1}) \quad (4)$$

Subject to:

$$w_{bt} \leq w_{b't} \quad \forall b \in B, b' \in B_b, t \in T \quad (5)$$

$$\underline{e}_r \leq \sum_{b \in B} a_{rb} (w_{bt} - w_{b,t-1}) \leq \bar{e}_r \quad \forall t \in T, r \in R \quad (6)$$

$$w_{b,t-1} \leq w_{bt} \quad \forall b \in B, t \in T \quad (7)$$

$$w_{bt} \in \{0,1\} \quad \forall b \in B, t \in T; w_{b0} \equiv 0 \quad \forall b \quad (8)$$

The objective function (4) maximizes the NPV of extracted blocks in the solution. Constraints (5) and (6) enforce precedences for each block b and operational resource limitations in each period, respectively. Constraints (7) enforce the w_{bt} variable definition, requiring that a block b extracted by period $t-1$ must also be extracted by period t . Constraints

(8) restrict all decision variables w_{bt} to the domain of $\{0, 1\}$.

3. Solution methodologies

The following methodologies should expedite solutions for (*CPIT*): (i) selecting the proper algorithmic settings to solve the linear programming relaxation at the integer program's root node; (ii) reducing the problem size by eliminating unnecessary variables; (iii) supplying an initial integer feasible solution (IIFS) to the optimizer; and (iv) tailoring a relaxation of the integer program based on the specific problem instance being solved. While Lambert et al. (to appear) provides these methodologies in detail, this paper summarizes, and presents excursions based on, items (iii) and (iv).

3.1 Initial integer feasible solution (IIFS). Providing the optimizer with an initial integer feasible solution (IIFS) reduces (*CPIT*) solution time by (i) precluding evaluation of dominated solutions and (ii) enabling more aggressive use of the optimizer's local search heuristic (IBM, 2009). For problem specifications in which operational resource limitations consist only of maximum capacities, a greedy or network-based heuristic (Chicoisne et al., 2012) may quickly find an IIFS. For problem specifications in which operational resource limitations also include minimum requirements, other approaches, such as a sliding time window heuristic (*STWH*), as used in Cullenbine et al. (2011), may be more likely to find an IIFS. In this regard, Lambert and Newman (to appear) present the *Maximum Value Feasible Pit (MVFP)* algorithm as an additional technique to generate an IIFS for problems including minimum operational resource limitations.

The *MVFP* algorithm consists of the following three phases:

Phase I: Find a subset M of blocks containing sufficient ore to satisfy the total processing requirement for a given time horizon τ .

Phase II: If M does not contain total tonnage sufficient to satisfy minimum production requirements over the entire time horizon τ , expand the set of blocks contained in M .

Phase III: Find an integer feasible block extraction sequence within M .

3.2 Tailored Lagrangian Relaxation (TLR). The Lagrangian relaxation method as described by Fisher (1981) is widely employed to solve integer programming problems, and was first used to solve the OPBS problem by Dagdelen (1985). In a Lagrangian relaxation formulation, certain constraints are removed from the constraint set and added to the objective function with a penalty multiplier (i.e., dualized), such that any solution which violates those dualized constraints penalizes the objective function value. In the OPBS problem, dualizing the resource constraints (6), which corrupt the underlying network formed by the precedence constraints (5), creates an easier problem to solve. In an iterative process, we solve the Lagrangian, check its solution for feasibility in the original problem and, if infeasible, modify the penalty multipliers and repeat the process. We continue in this fashion to find a solution that is both optimal in the Lagrangian and feasible in the original problem, thereby guaranteeing the solution is optimal for the original problem.

Table 1

Data sets and their characteristics.

Data set	Number of blocks			Tonnage (Mtons)	
	Total	Ore	Waste	$\sum_{b \in B} a_{1b}$	$\sum_{b \in B} a_{2b}$
10kA	10,819	1,423	9,396	60.57	7.92
Mrv25A^a	25,620	2,248	23,372	1,595.62	162.03

^a Extracted from “Marvin” test data set included with the Whittle software.

In each specific OPBS problem instance, dualizing different combinations of resource constraints provides different solution time performance. We tailor a Lagrangian relaxation formulation to the specific problem instance, where dualized constraints are those that are *unlikely to be difficult to satisfy* in the optimal solution. Next, we present our Tailored Lagrangian Relaxation (*TLR*) formulation, followed by a discussion of how our *MVFP* algorithm guides our selection of a dualization strategy. For an in-depth discussion of both our (*TLR*) formulation and our *MVFP* algorithm, see Lambert and Newman (to appear).

3.3 Tailored Lagrangian Relaxation (*TLR*) formulation.

Additional sets and data for (*TLR*):

- $\underline{\lambda}_{rt} / \bar{\lambda}_{rt}$: Lagrange multiplier for minimum/maximum constraint on resource r in period t
- $\underline{D} / \bar{D}$: set of resources for which minimum/maximum constraint is dualized
- $\underline{N} / \bar{N}$: set of resources for which minimum/maximum constraint is not dualized
- $\underline{D} \cup \underline{N} \equiv R$ and $\bar{D} \cup \bar{N} \equiv R$

(*TLR*) formulation:

$$(TLR) \max \sum_{b,t} c_{bt} (w_{bt} - w_{b,t-1}) - \sum_{t,r \in \underline{D}} \underline{\lambda}_{rt} \left(\underline{e}_r - \sum_b a_{rb} (w_{bt} - w_{b,t-1}) \right) - \sum_{t,r \in \bar{D}} \bar{\lambda}_{rt} \left(\sum_b a_{rb} (w_{bt} - w_{b,t-1}) - \bar{e}_r \right) \quad (9)$$

Subject to:

$$w_{bt} \leq w_{b't} \quad \forall b \in B, b' \in B_{b'}, t \in T \quad (10)$$

$$\underline{e}_r \leq \sum_{b \in B} a_{rb} (w_{bt} - w_{b,t-1}) \quad \forall r \in \underline{N}, t \in T \quad (11)$$

$$\sum_{b \in B} a_{rb} (w_{bt} - w_{b,t-1}) \leq \bar{e}_r \quad \forall r \in \bar{N}, t \in T \quad (12)$$

$$w_{b,t-1} \leq w_{bt} \quad \forall b \in B, t \in T \quad (13)$$

$$w_{bt} \in \{0,1\} \quad \forall b \in B, t \in T; w_{b0} = 0 \quad \forall b \quad (14)$$

$$\underline{\lambda}_{rt} \geq 0 \quad \forall r \in \underline{D}, t \in T \quad (15)$$

$$\bar{\lambda}_{rt} \geq 0 \quad \forall r \in \bar{D}, t \in T \quad (16)$$

Constraints (10), (13) and (14) enforce precedences, the

relationship between w_b variables for block b , and integrality in (*TLR*), similar to (5), (7) and (8), respectively, in (*CPIT*). Constraints (11) and (12) in (*TLR*) explicitly enforce minimum requirements and maximum capacities, for resources in $\underline{N}$ and $\bar{N}$, respectively, replacing constraints (6) in (*CPIT*). Constraints (15) and (16) require the Lagrangian multipliers to be non-negative.

A major challenge lies in identifying the best combination of resource constraints to dualize for the problem being solved, *prior to solving the problem*. While our *MVFP* algorithm generates an IIFS, in the process the *MVFP* also provides information that is useful for selecting a dualization strategy. Specifically, the (*TLR*) dualization strategy depends on (i) the amount of ore contained in the Phase I subpit, (ii) whether or not Phase II is required, and (iii) if Phase II is not required, the total tonnage contained in the Phase I subpit relative to the maximum production capacity. Below, we summarize our rationale for (*TLR*) dualization strategies based on *MVFP* performance, while Lambert and Newman (to appear) present in-depth explanations.

Phase I of the *MVFP* algorithm is designed to find a subset of blocks M containing ore adequate to satisfy both the minimum and maximum processing requirements. If the algorithm is unable to find such a subset of blocks, then the well-known “gap” problem exists. In this case, the *MVFP* provides no guidance regarding which constraints of the (*TLR*) to dualize, and further research is necessary to identify the best dualization strategy.

Phase II of the *MVFP* algorithm adds blocks to the subset M for the case in which M contains insufficient tonnage to meet the minimum production requirement. If Phase I produces such an M , then it should not be difficult to satisfy minimum processing when solving (*CPIT*) and, therefore, we dualize both minimum operational resource constraints in (*TLR*).

Phase II is not executed if Phase I produces an M such that all processing constraints and the minimum production constraints are satisfied. If the total material of the blocks in M is less than the maximum production capacity, then this implies that it should not be difficult to satisfy all operational resource constraints when solving (*CPIT*), and again we dualize both minimum operational resource constraints in (*TLR*). If however, the total material of the blocks in M exceeds the maximum production capacity, this implies it may be difficult to simultaneously satisfy both minimum processing and maximum production constraints when solving

Figure 1

The subset of blocks (M) from the 10kA data set, found during Phase I of the *MVFP* algorithm, for time horizon $\tau = 11$. Phase III of the *MVFP* algorithm searches within M for a feasible extraction sequence. Note that the “ragged” top levels and steep walls result from initial conditions present in the data set.

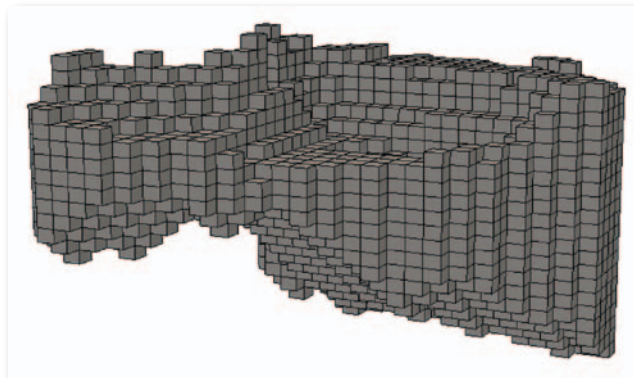
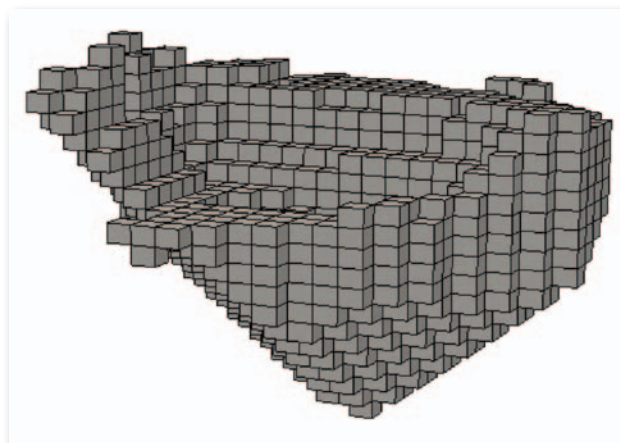


Figure 2

The subpit of blocks constituting the initial integer feasible solution, found from within the subset M (Fig. 1) during Phase III for the 10kA data set, time horizon $\tau = 10$.



(*CPIT*). In this case, we dualize the opposite constraints of maximum processing and minimum production in (*TLR*).

4. Results

While Lambert and Newman (to appear) test the above strategies on 12 openpit mine data sets, this paper presents excursion results based on two of those data sets. The 10kA data set is from a gold deposit consisting of 10,819 blocks, with an average block weight of approximately 5,600 t (6,200 st). The *Mrv25A* data set is a 25,620-block subset from the Whittle software’s fictional copper and gold deposit named “Marvin,” with an average block weight of approximately 62,400 t (68,800 st). Table 1 displays those data sets’ relevant summary characteristics, while additional details are available in Lambert and Newman (to appear). These data sets are used for illustrative purposes, and are general enough that other data sets including the same characteristics with different values (price, lower and upper bounds on resources, fixed cutoff grade, etc.), are suitable for similar analyses.

To demonstrate the *MVFP* algorithm’s effectiveness in finding initial solutions, we present graphical depictions of subpits found by the *MVFP* algorithm, and compare them with the final subpit found by the (*TLR*) optimization model, for the 10kA data set. To empirically validate our intuition behind the (*TLR*) dualization strategies, we solve problem instances with modified constraints for both the 10kA and *Mrv25A* data sets. We formulate models in AMPL, version 11.11 (AMPL, 2009) and then solve them with CPLEX, version 12.2.0 (IBM 2009), running on a Sun X4150, with 2 x 2.83 GHz processors and 16 GB RAM.

4.1 The *MVFP* algorithm. Phase I of the *MVFP* algorithm repeatedly solves (*UPIT*) for varying prices of ore to produce a maximum-valued subset M that satisfies aggregate processing requirements for a time horizon of τ . To provide additional flexibility when searching for a feasible extraction sequence in Phase III, we find a subset M for $\tau + 1$ periods in Phase I. For example, if we are interested in a final solution for a time horizon of $\tau = 10$ periods, in Phase I, we find a subset of blocks M containing sufficient ore for 11 periods of

processing (see Fig. 1).

Phase II of the *MVFP* algorithm expands M , if necessary, to add enough blocks so that the expanded subset contains sufficient total material for τ periods of production. The subset of blocks found in Phase I for the 10kA data set contains sufficient material to meet τ periods of production, and therefore, no Phase II expansion is required. In fact, the total material in the Phase I subset M exceeds the maximum production capacity for $\tau = 11$ periods, which is an indication that excess waste must be extracted in order to extract sufficient ore.

Phase III of the *MVFP* algorithm implements a *STWH* to find a feasible block extraction sequence within the subset M produced by Phases I and, if applicable, II. The blocks to be extracted in this sequence form the subpit shown in Fig. 2. This subpit’s relatively small size compared to that shown in Fig. 1 results from the *STWH* “finessing” the block sequences to achieve feasibility in the periods up through τ .

The overall intent of the *MVFP* algorithm is twofold: (i) to provide the (*TLR*) optimization model with a “good” starting solution, in order to reduce the overall search time required to find an optimal solution, or to prove optimality of that starting solution, and (ii) to provide information suggesting which resource constraints in (*TLR*) to dualize. The integer feasible sequence resulting from Phase III of the *MVFP* forms the basis of an initial integer feasible solution (IIFS) for the (*TLR*), while the dualization strategies are described previously at the end of Section 3.3.

Figure 3 is a graphical depiction of the final 10kA subpit to be extracted, where light grey blocks remain from the *MVFP* IIFS, and dark grey blocks are additions from the (*TLR*). This clearly demonstrates that the *MVFP* provides a reasonable-quality IIFS for this case. The main function of the Lagrangian procedure, for this data set, is in proving optimality by providing a solution with a minor expansion of the subpit along the lower back face.

4.2 (*TLR*) Dualization strategies from the *MVFP* algorithm. To illustrate two of our recommended (*TLR*) dualization strategies and the effect of minimum resource

requirements, we re-solve (*TLR*) without enforcing these minimum resource constraints for the 10kA and *Mrv25A* data sets. For this discussion, (*TLR*) refers to the problem previously introduced, including all minimum and maximum resource constraints, and (*TLR*) refers to the problem previously introduced, excluding the minimum operational resource constraints.

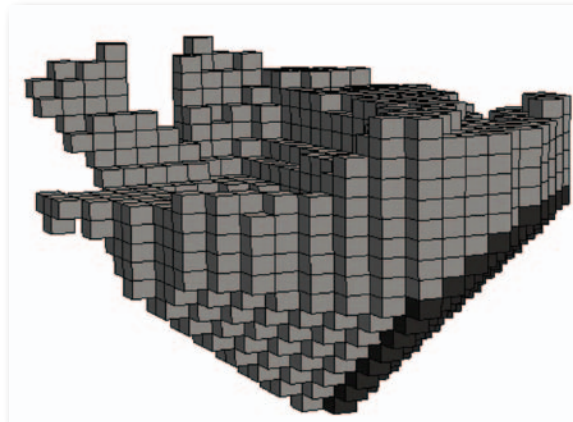
In performing the *MVFP* for the 10kA data set, the Phase I subpit contains sufficient ore for processing and total tonnage exceeding maximum production capacity. This implies that it is likely difficult to simultaneously satisfy the per-period minimum processing ($e_2 = 200,000$) and maximum production ($\bar{e}_1 = 1,000,000$) requirements when solving (*CPIT*). This is validated in the (*TLR*) solution in which tons of ore processed in the sixth and eighth periods (141,600 and 192,576, respectively) are insufficient to meet the minimum processing requirement, while tons produced in those same periods (999,606 and 996,348, respectively) are near the maximum capacity. This demonstrates *ex post* that the minimum processing and maximum production constraints should remain explicit in (*TLR*) for the 10kA data set, and illustrates how we select a (*TLR*) dualization strategy *ex ante* based on attributes of the *MVFP* Phase I solution.

In performing the *MVFP* for the *Mrv25A* data set, the Phase I subpit contains sufficient ore for processing and insufficient total tonnage to meet the minimum production requirement. This implies that it is relatively easy to simultaneously satisfy the per-period minimum processing requirement and maximum production capacity when solving (*CPIT*). This is validated in the (*TLR*) solution in which tons of ore processed in all periods are sufficient to meet the minimum processing requirement, even though those constraints are not present. This again demonstrates our (*TLR*) dualization strategy based on attributes of the *MVFP* Phase I solution, that the minimum processing constraints should be dualized, as they are likely irrelevant, and the minimum production constraints should be dualized, as the penalty multiplier can prevent their violation.

Before leaving the discussion concerning our *MVFP* dualization approach, we consider the possibility that our *MVFP* is an unnecessarily rigorous method by which to obtain the information needed for selecting a dualization strategy. *Ex post*, the very different dualizations appropriate for our two data sets (10kA and *Mrv25A*) imply that a dualization strategy might have been evident *ex ante* from the aggregate data in Table 1. While analyzing data prior to for-

Figure 3

The subpit of blocks to be extracted from the subset *M* (Fig. 1) according to the final (*TLR*) solution for the 10kA data set, time horizon $\tau = 10$. Light grey blocks remain from the *MVFP* initial solution (Fig. 2), while dark grey blocks are additional blocks scheduled for extraction by the (*TLR*).



mulating the model is beneficial, we find limited usefulness of aggregate statistics in predicting the difficulty of satisfying specific constraints.

For example, given that the stripping ratio (*SR*) is defined as $SR = \frac{\text{tons waste}}{\text{tons ore}}$, a higher *SR* might suggest more difficulty in satisfying the minimum processing constraint. However, while data from Table 1 shows that the stripping ratio for the *Mrv25A* data set exceeds that of the 10kA data set ($SR_{25A} = 8.85$, $SR_{10kA} = 6.65$), it is more difficult to satisfy the minimum processing constraint for the 10kA data set than for the *Mrv25A* data set. This apparent contradiction occurs because finding a feasible, inter-temporal extraction sequence is dependent on the ore-to-waste ratio available in each period *t*, given the sequencing of blocks in periods prior to *t*. More generally, the difficulty in satisfying the minimum processing constraint depends on the dispersion of ore in the deposit and the per-period operational resource requirements. As such, the value of our *MVFP* algorithm lies in providing a direct indication of the expected difficulty of satisfying the minimum processing constraint in each period.

4.3 Modified operational resource constraints. Reducing the time required to solve the OPBS problem is important to further decision makers' ability to find the "best" combination of capital equipment expenditures and consequent

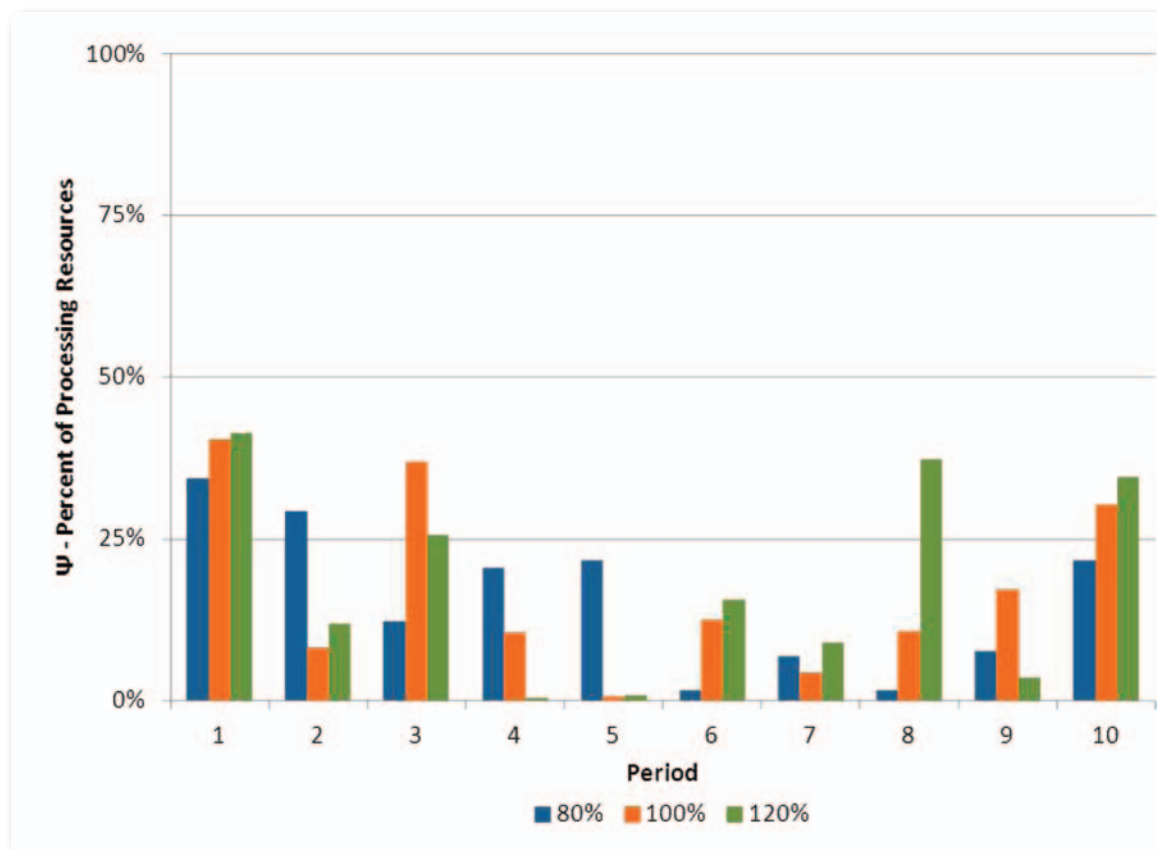
Table 2

Three scenarios created by varying operational resource requirements and capacities by $\pm 20\%$ of original levels, for the 10kA data set.

Operational resource	Percentage of original operational resource limitation					
	80%		100%		120%	
	Min	Max	Min	Max	Min	Max
Production	560,000	800,000	700,000	1,000,000	840,000	1,200,000
Processing	160,000	440,000	200,000	550,000	240,000	660,000

Figure 4

Tons of processed ore as a percentage (ψ) of the resource limit range, by period, for scenarios with 80%, 100% and 120% of original resource limits.



production schedules, thereby enhancing profitability. We assume that our operational resource constraints (minimum requirements and maximum capacities) are a function of the capital equipment purchased by the firm. For example, purchasing more and/or larger equipment should result in greater levels of production capacity. Therefore, to evaluate block extraction sequences resulting from various operational resource limitations, we create three scenarios by scaling the production and processing limitations (i.e., requirements and capacities) by $\pm 20\%$ for the 10kA data set, as shown in Table 2. Then, we use our techniques to solve (*TLR*) for a time horizon of $\tau = 10$.

In (*TLR*) solutions for each of our three resource-limit scenarios, the amount of ore processed in each period is an indication of the difficulty in simultaneously satisfying minimum processing and maximum production. To illustrate this, we use ψ defined in Eq. (17) as a normalized measure of the tons of processed ore as a percentage of the processing limit range.

$$\psi = \frac{\text{tons of processed ore} - \text{minimum processing requirement}}{\text{maximum processing capacity} - \text{minimum processing requirement}} \quad (17)$$

For example $\psi = 0\%$ corresponds to a solution in which the tons of processed ore equals the minimum processing requirement, and $\psi = 100\%$ corresponds to a solution in which the tons of processed ore equals the maximum processing capacity. Lower values of ψ then correspond to periods in which it is more difficult to satisfy both minimum processing and

maximum production. Figure 4 displays ψ , by period, for scenarios with 80%, 100% and 120% of original resource limits.

Our results show that simultaneously satisfying both minimum processing and maximum production requirements is a challenge, with values of ψ near 0% occurring in different periods for each scenario. Specifically, values of $\psi < 2\%$ occur in periods 6 and 8 for the 80% level, 5 for the original level, and 4 and 5 for the 120% level. Therefore, maintaining the minimum processing and maximum production constraints explicitly in the (*TLR*) formulation, as opposed to dualizing them, helps the (*TLR*) find feasible solutions. This again demonstrates that information provided by our *MVFP* algorithm effectively guides our dualization strategy.

Interestingly, for our 10kA data set, it appears challenging to simultaneously satisfy both minimum processing and maximum production in period 5, when constrained by the original resource limits (Fig. 4), yet, as noted in Section 4.2, minimum processing is violated in periods 6 and 8 when the minimum resource constraints are omitted. This dissonance in the challenging-to-satisfy periods occurs because by explicitly enforcing the minimum processing requirements, the optimization model must shift processing between periods to satisfy those constraints. This again highlights the challenges associated with knowing *ex ante* when, and where, constraint violations are likely to occur.

The time required to solve (*TLR*) after being provided an IIFS for each scenario also provides valuable information. To solve the 80%, 100% and 120% scenarios, the (*TLR*) requires 1,222, 2,416 and 1,131 seconds, respectively. Because the sce-

nario constrained by the original level of resources requires roughly twice as long to solve as the other two scenarios, this suggests that finding a near-optimal schedule at these resource levels is likely more challenging. This, in turn, could have robustness implications, suggesting that maintaining a production schedule constrained by the original level of resources may be more challenging than at levels in the other scenarios. Decision makers may benefit from this insight when making initial capital equipment decisions.

5. Conclusions

Our results and graphics illustrate how our *MVFP* algorithm generates an IIFS, and how information from that process is useful in suggesting a dualization strategy for tailoring the Lagrangian relaxation optimization model. The *MVFP* algorithm finds an initial solution, which the (*TLR*) then improves en route to proving optimality. The *MVFP* algorithm also provides information to guide dualization strategies. Given a Phase I subpit satisfying the processing requirements for a time horizon of τ , (i) if the subpit's material exceeds τ periods of the maximum production capacity, then this suggests dualizing the minimum production and maximum processing constraints, and (ii) if the subpit contains fewer than τ periods' worth of material needed to meet the minimum production requirement, then this suggests dualizing both the minimum production and minimum processing constraints.

In industry, practitioners modify optimization model output to achieve feasible schedules. The quality of software output and the time required for these "modifications" has not been extensively documented in the literature; therefore, we are unable to make a meaningful comparison between the total time required in industry practice and that required by our techniques. Our work attempts to incorporate details (minimum resource requirements) sometimes omitted in industry software or academic models, and to provide provably optimal (rather than heuristic) solutions to this specification of (*CPIT*).

Our techniques expedite solutions of the OPBS optimization problem, and optimal, or near-optimal solutions, are

useful in basic scenario analysis. Capital equipment configuration alternatives provide varying levels of operations (i.e., resource requirements and capacities). These, in turn, may provide different extraction schedules, each of varying value, with potentially diverse challenges. All this information should be available to the mining firm's decision makers. Our work demonstrates methods to generate this information relatively quickly and, therefore, could be useful in future research to explore various scenarios and capital equipment configurations. ■

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Discussion

Comments on “Coal workers’ pneumoconiosis prevalence disparity between Australia and the United States”

by X. Huang, Y. Luo and K. Luxbacher

Abstract ■ The authors provide a discussion of the paper, “Coal workers’ pneumoconiosis prevalence disparity between Australia and the United States,” a peer-reviewed paper that appeared in the technical papers section of the July 2012 issue of *Mining Engineering* magazine. The original authors, G.J. Joy (gjoy@cdc.gov), J.F. Colinet (jcolinet@cdc.gov) and D.D. Landen (dlanden@cdc.gov), respond.

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Abstract

Despite a strong association between quartz content in mixed coal dust and the prevalence of coal workers’ pneumoconiosis (CWP), as observed by Joy et al. (2012), increasing evidence demonstrates that bioavailable iron content in the coal is a likely causative compound that cannot be ignored. Instead of asking which com-

pounds cause CWP, a more pragmatic question should be what compound(s) in the mixed coal dust prevents CWP from rising in coal workers. Here, we discuss the potential use of calcite as a protective agent to prevent CWP in the Appalachian coal field.

Discussion

The recent increase in the prevalence of coal workers’ pneumoconiosis (CWP) in the U.S., particularly in the Appalachian coal fields, calls for new research to eliminate CWP in the coal industry (Laney et al., 2010; NIOSH, 2008). The July 2012 report by Joy et al. in *Mining Engineering* concludes that, despite higher levels of respirable coal dust in Australian underground coal mines, the lower respirable quartz content of the dust may contribute to the lower incidence of CWP in Australian coal workers as compared to their U.S. counterparts (Joy et al., 2012). While the authors addressed several limitations that impact interpretation of the presented findings, we are concerned by the lack of discussion of the role of

bioavailable iron (BAI) in the mixed coal dust, which may be part of the cause of the regional disparity in CWP prevalence.

A fossil fuel, coal is an aggregate of heterogeneous substances composed of organic and inorganic materials (Meyers, 1982). Among all known risk components in the mixed coal dust, we agree with the authors that coal rank or carbon-centered free radicals do not play a significant role in CWP development (Huang and Finkelman, 2008). It appears to be BAI, and to a lesser extent, quartz, that play major roles in coal dust-induced pathogenesis. Despite an observation of a positive association between CWP and quartz content in the report, with a correlation coefficient $r = 0.68$, $p < 0.05$ (Joy et al., 2012), other epidemiology studies have shown no or inverse links between CWP and the quartz content of coal (Borm and Tran, 2002). Conversely, studies using coals from the U.S. and EU have demonstrated positive associations between BAI and CWP prevalence (McCunney et al., 2009). In fact, it has been shown that

X. Huang, associate professor, Department of Environmental Medicine, New York University (NYU) School of Medicine, New York, NY; Y. Luo, associate professor, Department of Mining Engineering, College of Engineering and Mineral Resources, West Virginia University, Morgantown, WV; K. Luxbacher, member SME, assistant professor, Department of Mining & Minerals Engineering, Virginia Tech, Blacksburg, VA. Discussion of paper number TP-10-045. Email: Xi.Huang@nyumc.org.

CWP prevalence in seven U.S. coal mining regions correlates with BAI levels in the coals, with a correlation coefficient $r = 0.94$, $p < 0.0015$ (Huang et al., 2005). Biological studies show no role for coal-borne quartz, but strong mechanistic links between BAI content in coal and reactive oxygen species, as well as inflammatory responses associated with CWP (Huang and Finkelman, 2008).

Perhaps instead of arguing whether BAI is more important than quartz or vice versa in causing CWP, a more pragmatic question should be what compound(s) in the mixed coal dust prevents CWP from rising in coal workers in the western U.S. Both BAI and quartz are present in western coal mines, such as those in Utah and Colorado. We have found that BAI is stable only under acidic pH; western U.S. coals containing high levels of calcite (CaCO_3) have high pH and, consequently, lower BAI and toxicity (Huang et al., 1998). Conceivably, this calcite-mediated lower toxicity accounts for the relatively low CWP prevalence observed among coal workers in the western U.S. According to the CaO levels in the high-temperature ashes, we have estimated that calcite levels in western U.S. coal regions are at 2-5% on a per weight basis (Huang et al., 1998; Zhang et al., 2002). Calcite also reduces endogenous levels of cellular iron (Aladdin et al., 2012), diminishing an important source of iron that can be sequestered by silica (Fubini et al., 2001). Interaction of silica with cellular iron is thought to play a role in silicosis and, thus, calcite could potentially prevent this disease as well.

Taken together, these findings suggest that calcite may have the potential to prevent CWP in Appalachian coals, regardless of the pneumoconiotic effects caused by either BAI or quartz or both. Although calcite present in the mixed coal dust is inhaled by coal workers in the western U.S., the safety of calcite as an additive in the Appalachian coals is an urgent issue to be investigated by the medical community. The feasibility of applying calcite to prevent CWP before or during the mining process should be considered and tested by mining researchers. Thus, while efforts to identify causative compounds must continue, further research is warranted to explore the potential use of calcite as a novel strategy for preventing CWP.

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Joy et al. respond

The authors appreciate the thoughtful comments offered by Huang, Luo and Luxbacher in their discussion of our paper on the disparity in the incidence of coal workers' pneumoconiosis (CWP) between Australia and the United States (Joy et al., 2012).

The association of biologically available iron (BAI) in coal with CWP is intriguing, and we certainly support further investigation of this theory in pursuit of the toxicological basis of CWP. Our paper did not address the BAI issue because at the time of preparation, and to our knowledge now, information on the BAI content of Australian coals was not available. Consequently, we did not explore this issue.

If the role of BAI in the development of CWP is pursued, we would suggest using airborne respirable coal mine dust collected from relevant coal regions in lieu of dust prepared from channel samples, as the airborne dust is the ultimate agent of exposure. We also suggest for future analysis of the BAI theory, the adoption of recent CWP prevalence data rather than the data published by Morgan (Morgan et al., 1973). The overall rates of CWP have fallen about 10-fold since the Morgan report, and the current predominance of CWP in the southern Appalachian region is not observed in the earlier report.

We do have reservations about the proposal to add respirable calcite dust to the workplace atmosphere as a means to manage the pH of the coal and thus the production and perseverance of BAI. The surest and safest way to prevent dust-induced lung disease is to prevent inhalation of dust, not to generate new combined exposures that might have unintended health consequences. There is reason for concern about inhalation of calcite-treated dust. The adverse respiratory health effects experienced by emergency responders who inhaled World Trade Center (WTC) dust have been attributed, at least in part, to the high alkalinity of that dust (Landrigan et al., 2004). Calcite was an important component of WTC dust and contributed to its alkalinity (McGee et al.,

2003). A historical example of an effort to limit the toxicity of an inhaled dust by inhaling an additional agent was the attempt to use aluminum inhalation to prevent silicosis. This may have had unintended neurotoxic consequences (Rifat et al., 1990).

Even if inhalation of calcite-treated dust was shown to be safe and to have efficacy in preventing human disease, there would be technical challenges to implementation. The approach would require engineering and technological advances to allow production of a uniform aerosol of calcite with the same aerodynamic equivalent diameter as the local coal mine dust, as well as a near-real time method to assess the concentrations (or perhaps particle numbers) of coal mine dust and calcite, so that the desired ratio is maintained. It would also require significant legislative action to redefine the appropriate exposure limit.

Regardless of whether BAI – alone or with any other component of coal – is demonstrated to be the causative factor of CWP, the safest, surest and most feasible control approach would be management of the airborne respirable dust concentration to a level shown to be protective. The fall of CWP rates with implementation of respirable coal mine dust exposure limits has established the validity of this approach. Identification of the active disease-inducing agent may offer opportunities to improve this control mechanism.

Finally, the commenters' discussion quotes a referenced report as stating "Biological studies show no role for quartz but strong mechanistic links between BAI content in coal and reactive oxygen species as well as inflammatory responses associated with CWP." A key potential role for quartz inhalation by coal miners is causation of the pneumoconiosis silicosis, a different disease from CWP that has a similar radiographic appearance. Depending on their exposures, coal miners can develop either type of pneumoconiosis (Laney et al., 2010).

Inhaled respirable quartz is highly toxic. The same referenced report (Huang and Finkelman, 2008) states on page 52: "A single instillation of silica in mice leads to a marked increase in the level of lung TNF- α production." Also, page 53 of that same paper states: "it was shown that quartz as cumulative exposure was a highly significant predictor of polymorphonuclear leukocytes (PMNs) counts in bronchoalveolar lavage fluid, a marker for lung injury." Others (van Berlo et al., 2010; Warheit et al., 2007; Rao et al., 2004; Kuempel et al., 2003) have also reported on the toxicity of quartz in vitro or in vivo. Thus, the ability of quartz to induce pulmonary toxicity and silicosis is highly relevant to a comparison of pneumoconiosis in U.S. and Australian coal miners.

We agree that elucidation of the ultimate causal factor(s) underlying coal workers' pneumoconiosis would be a substantial advance, and would be of enormous benefit to the health of coal miners. To this end, all reasonable candidate components should be thoroughly examined. Application of the knowledge gained during this endeavor at the mine level could contribute to the end of a historic occupational disease. ■

Respectfully,

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J.F. Colinet (jcolinet@cdc.gov)
D.D. Landen (dlanden@cdc.gov)

The findings and conclusions in this response are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

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MEC and Edison Tech produce copper video

by Sharon Schonhaut, manager MEC

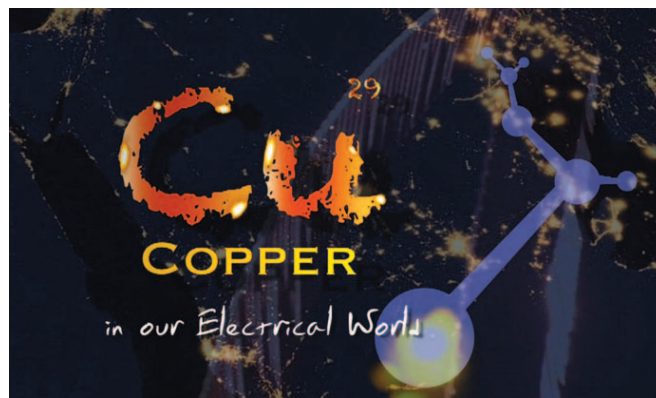
The Minerals Education Coalition (MEC) has collaborated with the Edison Tech Center of Schenectady, NY to produce an impressive new video, "Copper in our Electrical World." It will have its premier showing at SME's Annual Meeting on Monday, Feb. 25 at the MEC's technical session from 2 to 4 p.m. in the Colorado Convention Center. Come join us on the red carpet.

The video tells the story of how copper deposits were formed, copper's unique properties, which make it so versatile and valuable, how it is mined and processed, and the variety of products that contain copper — products that are essential to our everyday lives and lifestyles.

Presenters in the video include Jessica Elzea Kogel, SME's 2013 president and geologist with Imerys; Corby Anderson, professor of metallurgical and materials engineering at the Colorado School of Mines; Ishwara Bhat, electrical, computer and systems engineer at the Rensselaer Polytechnic Institute, and Frank Wicks, mechanical and nuclear engineer with the Edison Tech Center.

This video could not have been made without the tremendous support it received from Freeport-McMoRan Copper & Gold. Filming done at its Morenci Mine in Arizona was made possible by Red M. Conger, president Americas; Will Wilkinson, vice president Africa; Eric E. Kinneberg, director of external communications; Linda S. Hayes, internal communications; David Rhodes, Morenci general manager of administration; Josh Olmsted, senior vice president of Morenci; Linda Stacy, scheduling; Frank Maldonado, safety; and Danny Leyvas, Heber Sullivan and Manny Garcia, transportation.

Thanks as well to the leadership of the Edison Tech



Opening screen shot in the MEC video presentation on copper.

Center, Craig Cantello, president, and Bill Kornrumpf, treasurer, for their belief in the video's concept and help in promoting the importance of the message to our audiences.

Most importantly, Mike Whelan, the individual who conceptualized, wrote, filmed and edited this video deserves special recognition. His vision to create a new and exciting presentation for high school students and the general public was the guiding force behind every aspect of production. Whelan worked with MEC's curriculum coordinator, Amy Helgeson, to develop the story line, wrote the script and contacted experts in the field to be interviewed. He designed and assembled the special equipment needed to give authenticity to the movement of copper from the excavation site to the grinders, through metallurgical processes, transport loading and, eventually, identifying copper's many uses in products. ■

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Fine Grind

SME News

Top ten things for a metallurgist to do at the SME Annual Meeting

by Richard Johnson, BHP Billiton

Number 10 — Share the dumbest miner jokes you have heard with other metallurgists. Then explain the punch lines to the miners. This can take a while.

Number 9 — Display your copy of the Mineral & Metallurgical Division (MPD) calendar. It's free, and it's in your packet. This is great way to advertise, and it raises a ton of money for student scholarships. We really do like students.

Number 8 — Attend the SME Keynote Session on Monday morning. The subject is "Mining: It's About the People." Wonder what that is all about ... people.

Number 7 — Attend the MPD Plenary Session where the Gaudin, Richards and Wadsworth presentations will all be given from 2-4:30. Wow!

Fine Grind serves as a forum for the presentation and discussion of facts, ideas and opinions pertaining to the interests and technology of the Mineral & Metallurgical Processing Division. Accordingly, all material published herein is signed and reflects the individual views of the authors. It is not an official position of SME or the division. Comments by readers will be referred to the division for response. The division chair in 2012 is Jayson Ripke.

Number 6 — Find and share a patron with the loud-mouthed bald guy (LMBG). Look for him at the convention. His name tag says it all.

Number 5 — Walk the exhibit hall with several friends to see who can enter the most giveaway contests and collect the

most pens. Last year, a guy won an iPad by being nice and listening to what the supplier had to say — go figure.

Number 4 — Attend the "Innovation in Metallurgical Processing Symposium" sessions. The keynote lecture and reception is a ticketed event on Monday evening at 5 p.m. The technical sessions start Tuesday at 2 p.m.

Number 3 — Find out the answers to the question "What if?" by Michael Rayburn at the Operator's Forum on Tuesday afternoon from 4-5 p.m.

Number 2 — Enjoy the MPD Scotch Nightcap. This social function-scholarship fundraiser is sponsored by ASD Inc. and Weir Minerals. One hundred percent of the proceeds from this event go to the MPD scholarship fund for college students who want to make a career in the mining industry. The event will be an evening of renewing friendships and making new ones, while enjoying hors d'oeuvres, live music and cocktails. Each attendee receives two complimentary drink tickets to use during the event.

And the **Number 1** thing for a metallurgist to do at the SME Annual Meeting is to get involved in MPD by participating in the MPD Unit Committee planning session on Sunday from 2-3 p.m. and by attending the MPD luncheon (ticketed event) on Wednesday at 12 noon. At the Luncheon, award winners will be acknowledged, and Leigh Freeman will address us by expanding on the SME Keynote Session. There is a brief business meeting afterward, and all are invited to attend. ■

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Randy Brandt, Oakland, CA
Jenny Bravo, Costa Mesa, CA
Adam R. Brewer, Rapid City, SD
Justin D. Brick, Rapid City, SD

Christian D. Briones V., Lima, Peru
Jesse R. Brown, Rapid City, SD
Brody A. Buer, Moorecroft, WY
Ben M. Burke, Canaan, ME
Yasser Yamin Calderon P., Lima, Peru
Thomas E. Callicrate, Washoe Valley, NV
Giancarlo Calzada Canares, Lima, Peru
David Camerlengo, El Segundo, CA
Harold M. Camero Sr., Lima, Peru
Pedro Cardenas, Lima, Peru
Dylan R. Carr, Gunnison, CO
Jose G. Carrasco, Socorro, NM
Benjamin C. Clark, Gunnison, CO
Elisabeth Clausen, Clausthal Zellerfeld, Germany
Brian W. Claybourn, Lakewood, CO
Stacey G. Cochiara, Denver, CO
Ethan J. Couter, Chippewa Falls, WI
Michael Curtis, Foothill Ranch, CA
Kathryn K. Dehn, Wardner, ID
Jackson W. Delgado L., Lima, Peru
Jose Antonio Dioses De La Cruz, Lima, Peru

Cihan Dogruoz, State College, PA
Troy R. Doyle, Tucson, AZ
Robert L. Florich, St. Louis, MO
Christian J. Fredrickson, Rapid City, SD
Johnathan J. Fuerstenau, Rapid City, SD
John M. Furlan, Grovetown, GA
Greeshma Gadikota, New York, NY
Mehdi Galouei, Socorro, NM
Tara S. Gerhardt, Saginaw, MI
Setareh Ghaychi A., Socorro, NM
Arash Ghoorchian, Socorro, NM
Cody L. Goetz, Rapid City, SD
Willi Jose Gonzales M., Lima, Peru
Thomas W. Gonzales, Tucson, AZ
Nancy M. Gracia-Gungor, Tucson, AZ
Alex Guevara A., Lima, Peru
Derek S. Gustafson, Rapid City, SD
Kyle B. Handy, Lakewood, CO
Andrew P. Hanneke, O'Fallon, MO
Kady E. Hansey, Bowman, ND
Anna K. Hanson, Rapid City, SD

(Continued on page 52)

Young Leaders hold a mentor session with Jurgen Brune

by Susan Moore, NIOSH

Throughout the year, the Young Leaders Committee invites an established member of the mining industry to mentor its members across a variety of topics. Jurgen Brune, our most recent mentor, is a research professor at the Colorado School of Mines and has extensive experience in many areas of the industry. He has worked as a production foreman, slope stability engineer, planning manager, ventilation engineer, assistant mine superintendent, manager of engineering services, health and safety researcher, and research director. The committee is pleased to share a synopsis of his insights into the industry.

Topic: Workforce attrition — the challenges our next generation of leaders face with having less experience and more responsibility.

It is a great time to be a mining engineer, with companies providing firm job offers to our nation's graduates. The young engineers, and their soon-to-be midcareer precursors, should embrace the increased responsibility they stand to inherit as our most experienced in the industry continue to retire. But, managing this increased responsibility requires a proactive approach with the industry's more junior members actively seeking out mentorship and guidance opportunities. Junior industry members should expect to be assigned to teams with people generally of their same experience level, yet the requirement to produce results will not diminish.

Don't hesitate to ask for help when you need it. Seek out those experienced members of the industry, receive the guidance you need and demonstrate your interest in knowledge growth. Make sure you are well prepared for the interaction.

Topic: Continuing education — the pros and cons of formalized opportunities, such as mentoring, classes, short courses, training opportunities, versus expanding industry experience by accepting more responsibility.

There are very few Ph.D.s in the mining industry that are without jobs, but it's important to be prepared. A job can be lost at any time, not necessarily related to your individual performance. Networking and a high degree of education are critical for quickly identifying new opportunities after set-backs. Many companies provide support to employees who are willing to go back to school; seize this opportunity.

Training opportunities that exist within a company are also important. These may include such topics as dealing with or managing people, working a safety program in a company, writing reports, conducting economic feasibility studies and identifying talents in the people you supervise.

These courses are all part of the corporate culture, and you will be expected to participate to ensure you are in line with the corporate philosophy.

Short courses, such as those offered at the SME Annual Meeting, expand understanding and knowledge in critical areas. However, these require company investment. Talk to your boss in advance of the SME meeting and request his or her support to attend the short courses. Make a good case for your need by demonstrating a clear benefit to your company. Seeking out the appropriate training is a prerequisite to accepting more responsibility. Learning a second language is crucial in that it makes employees more versatile by opening opportunities to take jobs in other countries.

If there are opportunities, volunteering early could be the best strategy. Being the first to participate in a new program usually offers more rewards than risks. Funding may dry up later.

Topic: Managing difficult situations — successes and failures.

Failures will be experienced with the same frequency as successes. The willingness to learn from failures is critical. It is an opportunity to get better and readjust your career. Failures can be good. Failures should be viewed as opportunities. You learn much more from failures than successes. Successes, initially, are easier to deal with because they often come with promotions and monetary reward. Successes also result in increased expectations. You should be prepared to manage the stress that comes with increased expectations following your successes.

Fitting into a company culture goes both ways — the company needs to see if the employee is a fit, and the employee needs to assess the company in the same way. Companies communicate clearly and early to employees whom they see as a good fit by offering promotion opportunities. An employee who does not feel the company is a good fit must determine if other jobs within the same company would improve the fit.

You need to make your wishes known to your superiors and make a case for why you would perform well and bring more value to the company in other areas where you have an interest. Sometimes you may need to accept an unpleasant job in the short term with the knowledge that there will be other opportunities waiting for you later. ■



BRUNE

Correction

In the Fine Grind article, "Cyanide method advances to international standardization," **ME**, Dec. 2012, p. 72, the author would like to make the following correction: The free cyanide limit in drinking water for the U.S. Environmental Protection Agency is 0.2mg/L. ■



LE VIER

Great Western Minerals Group Ltd. has appointed **MARC LE VIER** (SME) to the position of president and chief executive officer and to its board of directors. Recently, Le Vier was president, chief executive officer and a director of Texas Rare Earth Resources Corp. where he oversaw the completion of a preliminary economic assessment and established the strategic direction and vision for the company. Prior to that, he

spent more than 20 years with Newmont Mining in senior metallurgical and management positions, including general manager of the Zarafshan/Newmont joint venture and senior director of Metallurgical Research and Development.

SCOTT P. LAWSON has joined Newmont Mining Corp. as senior vice president, technical services. Lawson's initial focus will be to finalize the integration work with the solutions and innovation and business excellence teams and oversee the company's business excellence, mining technology, mine engineering, metallurgy, innovation, integrated resource modeling and energy functions. Most recently, he was senior vice president, engineering services, for Peabody Energy. He has also worked for Rio Tinto and Kennecott Utah Copper.



STALEY

KEITH STALEY, Legion of Honor member of SME, turned 100 years old on Jan. 13, 2013. Staley is a graduate of the Colorado School of Mines and served in the U.S. Army 42nd Engineer General Service Regiment. During his long mining career, he worked for Asarco, United Clay Mines, Phelps Dodge and Magma Copper. He retired in 1970 as general manager of Magma's San Manuel operations. He now enjoys gardening, lapidary, stone cutting and silversmithing.

Tetra Tech has recently hired **JOHN M. YOUNG** (SME), as vice president of mine closure based in Reno, NV. He will



YOUNG

expand Tetra Tech's services in mine closure and remediation. Young has more than 35 years of global experience in environmental, health and safety management, drilling, minerals exploration, mine development, due diligence reviews and mine reclamation and closure activities. He has managed three environmental impact statements for gold mines in Nevada. ■

Membership

(Continued from page 50)

Vic Harding, Phoenix, AZ
Jordan R. Helgesen, Rapid City, SD
Behzad Hemami, Socorro, NM
Heather R. Hensman, Powell, WY
Jakob Herrmann, Aachen, Germany
Daniel J. Heuston, Corpus Christi, TX
Taylor J. Hindes, Gunnison, CO
Todd Hooper, Chicago, IL
Michael C. Huh, Los Angeles, CA
Mary Jacobson, Hayden, ID
Logan Jensen, Elko, NV
Sarah L. Johnson, Custer, SD
Doug M. Jones, W. Vancouver, BC, Canada
Mark E. Jones, Golconda, NV
Skyler B. Kehn, Plankinton, SD
George Kendrick, Yarmouth, ME
Terrell G. Killingsworth, Denver, CO
Kyle R. King, Rapid City, SD
Edouard A. Landao, Swanbourne, WAS, Australia
Tony Lesiak, Toronto, ON Canada
Tony Ly, Rapid City, SD
Ryan R. Lyle, North Bay, ON, Canada
Mark Mallory III, Portland, OR
Wardan M. Martins, Round Mountain, NV
Natalie A. Maturen, Saginaw, MI
Justin Mauck, George West, TX
Jonathan R. McCallum, Gunnison, CO
Mac McCreless, Denver, CO
Kristina M. Miles, Whitewood, SD
Adam Miller, Denver, CO
Andrew S. Miller, Carlsbad, NM
Strider D. Miller, Rapid City, SD

Wmil Milosavljevic, Englewood, CO
Jennifer A. Mlynarek, Midvale, UT
Joseph Monks, Rapid City, SD
Cale E. Moore, Rapid City, SD
Shirin Nasiri, Toronto, ON, Canada
Skyler L. Newcomb, Rapid City, SD
Clider Nino C., Lima, Peru
Clint C. Noble, Jacksonville, FL
Jonathan O. Ntoni, Edmonton, AB, Canada
Nels J. Ojard, Duluth, MN
Rafael Olivares R., Lima, Peru
Tom E. Osborn, Elko, NV
James C. Owen, Salt Lake City, UT
Ronald T. Parratt, Reno, NV
Gary A. Peck, Reynoldsburg, OH
John N. Persell, Moscow, ID
Scott B. Peters, Rexburg, ID
Aaron T. Posey, Rapid City, SD
Alberto Ramos San Miguel, Lakewood, CO
Jessica Rath, Golden, CO
Daniel A. Requejo I., Lima, Peru
Regina R. Rocha O., Lima, Peru
Jean-Francois Roche, Algiers, Algeria
Julio Cesar Rodriguez P., Lima, Peru
Antonio Romero H., Medellin, Colombia
Mark J. Rose, Saginaw, MI
Tanner T. Ryan, Goodhue, MN
Ethan Sager, Rapid City, SD
Andreas Tuhafeni Salom, Windhoek, Namibia
Michael J. Savage, Wilmington, IL
Ankur K. Shah, Denver, CO
Kassandra P. Shimek, Black Hawk, SD
Myron W. Smith, Miami, AZ

Randy J. Smyth, Coquitlam, BC, Canada
Fred Sosa N., Ayacucho, Peru
Julia R. Spears, Shingle Springs, CA
Mathew S. Spencer, Rapid City, SD
Thomas E. Starr, Rapid City, SD
Aaron Steeg, Houghton, MI
Hamid R. Taghavi, Morenci, AZ
Ekrem Tamkan, Rapid City, SD
Xu Tang, Morgantown, WV
Nestor Tarazona Y., Lima, Peru
Jose Martin Tarrillo G., Lima, Peru
F. Doug Taylor, Winnemucca, NV
Tyler Thompson, Moscow, ID
Alex Tift, Golden, CO
Zoljargal Tsogoo, Rapid City, SD
Steven Tyler, Parker, CO
Cynthia Urda Kassis, New York, NY
Ramon Urquiola, Rapid City, SD
Daniel J. Van Overbeke, Rapid City, SD
Bryan P. Velarde M., Lima, Peru
Joseph A. Velazco Q., Lima, Peru
Priyesh Verma, Morgantown, WV
Jordan M. Verslues, Rocheport, MO
Valerie T. Wade, Pinehurst, ID
Anthony R. Wagner, Jacksonville, FL
Lee-Anna M. Walker, Scottsdale, AZ
Jason D. Weber, Teutopolis, IL
Rion A. Westfall, Tucson, AZ
Mark J. Whitfield, Walton-On-Thames, England
Colin Whitmore, Denver, CO
Joshua D. Wyatt, Madison, SD ■

SME presents awards; Announces Distinguished Members

The Distinguished Member class of membership was established within SME to honor those members who achieve distinction deemed worthy of special recognition. It

acknowledges members who have attained eminence in the industry, the academic world or who have made unusually significant contributions to a section, to SME or to AIME.

Kadri Dagdelen

Kadri Dagdelen received his B.S., M.S. and Ph.D. degrees in mining engineering from the Colorado School of Mines and an M.E. in geostatistics from the Ecole des Mines in Paris, France. Dagdelen started his professional career as a mining engineer at Homestake Mining (now Barrick Gold Corp.) in 1985. He served as manager of technical services at Homestake before leaving to join CSM as an assistant professor in 1992. He has been on the CSM academic faculty for the past 21 years. During this time, he has been involved in numerous research and consultant projects in the areas of mining and environmental geostatistics, mine planning and scheduling, cutoff-grade optimization using large-scale mathematical optimization and

operations research techniques.

Dagdelen was promoted to associate and full professor at CSM in 1998 and 2002, respectively, and served as the head of the Mining Engineering Department between 2008 and 2012.

Dagdelen served on the SME Board of Directors for six years, as well as serving as chair of other professional societies that support the mining industry. He continues to teach and do research work at CSM and serves as a nonexecutive board member on the board of directors of Randgold Resources.



DAGDELEN

Raymond Henn

Raymond Henn is a senior consultant with Brierley Associates, LLC in Denver, CO. He has more than 40 years of experience in heavy and underground construction and has held positions as a surveyor, field engineer, superintendent and construction manager. He has served on 30 dispute review boards, serving as chair on 13 of these boards, and has been a construction arbitrator.

Henn is the past president of the American Underground Construction Association. He received the American Society of Civil Engineers' (ASCE) 2002 Roebling Award in Construction Engineering and the Underground Construction Association of SME's 2008 Outstanding Individual Award. He has authored three ASCE textbooks on grouting associated with underground construction and has published more than 25 professional papers.

Henn received his Ph.D. in mining and earth system engineering from the Colorado School of Mines. He has been a SME member for 38 years and is a member of the Underground Construction Association (UCA) Division of SME. He is currently an adjunct professor in the Mining Engineering Department at CSM and is the UCA of SME's student chapter faculty advisor. He is leading the efforts of the UCA to publish a handbook on tunneling and underground construction. Henn is a member of the ASCE, the International Society of Explosives Engineers, the Dispute Resolution Board Foundation, the Moles and the Beavers.



HENN

Timothy G. O'Neil

Timothy G. O'Neil worked for 26 years in the SME publications department as an editor for *Mining Engineering* magazine. He provided guidance and interaction with all segments of the mining industry for readers in nearly 100 countries. In so doing, *Mining Engineering* maintained its position as the foremost periodical in the global mining industry.

O'Neil gave startup assistance and continuing support to the *Minerals & Metallurgical Processing (M&MP)* journal and managed *Transactions*, the annual bound volume of technical papers. He also provided personnel, budgeting

and managerial support for the publications department, which maintained its low turnover, high morale, efficiency and productivity.

When O'Neil retired in 2006, *Mining Engineering's* advertising sales had reached an all-time high. A digital typesetting workflow had cut costs, saved time and improved the interaction with SME's printing company. *M&MP*, continuing its strong editorial presentation, had increased its



O'NEIL



circulation and showed a profit. And an online peer-review system for technical papers had been implemented.

O'Neil received a B.A. degree, with a divisional major in biology, philosophy and psychology, from Regis College and an M.A. in journalism from the University of Colorado. He is an Honorary Life Member of the National Mining Hall of Fame and Museum and currently serves on its board of

directors. He spent five years as the public relations and publications director at AMAX's Henderson Mine and received an Award of Excellence from the International Association of Business Communicators for helping to make a film about Henderson. He also spent several years as a newspaper reporter and editor, and taught English, reading and journalism for three years.

Harry M. Parker



PARKER

Harry M. Parker holds B.S. and Ph.D. degrees in geology and an M.S. in statistics from Stanford University, and an A.M. degree in geology from Harvard University. He worked as an exploration and staff geologist at the Hanna Mining Co., then joined Fluor Mining and Metals as a mining geologist. In 1989, he joined MRDI as partner and held numerous positions at MRDI and its successors, Agra and AMEC. He is currently technical director.

Parker has provided consulting services to the mining industry in uranium, coal, copper, gold, nickel and platinum group elements. He contributed a chapter on uranium resource estimation for the SME's *Handbook of Surface Mining* and a keynote paper on reconciliation for the re-

cent 35th APCOM Symposium.

In 2006, Parker became co-chair of SME's Registered Members Committee and led the development of evaluation standards for candidates. He now serves as co-chair of the SME Resources and Reserves Committee and is one of two SME representatives on the Committee for Mineral Reserves International Reporting Standards. He has been active in mapping resources and reserve reporting terminology between the minerals and petroleum industries for the International Accounting Standards Board and establishing standards for technical disclosure accompanying financial disclosure. He has also maintained a dialog with the U.S. Securities and Exchange Commission regarding the use of the *SME Guide for Reporting Exploration Results, Mineral Resources and Mineral Reserves* as the basis for updating the SEC's *Industry Guide 7*.

SME Awards

President's Citation to Red Conger and Richard M. Whiting

"The society recognizes Red Conger and Richard M. Whiting for their service as co-chairs of the SME Foundation's Creating Global Prosperity: The Campaign for Mining. Their leadership and guidance directed the campaign toward a clearly defined path to success – one that positions the SME Foundation for continued growth and strengthens the Society's programs."



CONGER

Conger currently serves as president of Freeport-McMoRan Americas. He is responsible for seven mining operations in North America and four mining operations in South America, which includes 12,000 employees and an annual copper production of 1.08 mt (2.4 billion lbs). He also has environmental and corporate social leadership responsibilities in three countries.

For the past 35 years, Conger has served in a multitude of senior management roles of increasing responsibility in the copper mining industry and is considered a leader in change management and production efficiency. He began his career in 1977 at Kennecott's Bingham Canyon, which eventually led to a 20-year career with Phelps Dodge Corp.

overseeing all aspects of mining and processing at several North American and all South American operations.

Conger received the Colorado School of Mines Distinguished Achievement Medal 2007 and the 2009 Daniel C. Jackling Award for his significant contributions to technical progress in mining. He is a board member for the National Mining Association. He holds a B.S. degree in mining engineering from Colorado School of Mines and has completed postgraduate executive management studies at Duke Fuqua School of Business.

Whiting previously served as president, chief executive



WHITING

officer and director of the Patriot Coal Corp., a leading coal producer in the eastern United States. Prior to the spin-off of Patriot from Peabody Energy in 2007, Whiting was Peabody's executive vice president and chief marketing officer. He also served as president, chief operating officer and director of Peabody. During his tenure at Patriot Coal, Whiting was a member of the Executive Committee of the National Mining Association (NMA), chair of NMA's Audit and Finance Committee and chair of CoalPac.

Whiting is the former chair of NMA's Safety and Health Committee, the former chair of the Bituminous Coal Operators' Association and a past board member of

the National Coal Council. He is currently a director of the SME Foundation. He holds a B.S. degree in mining engineering from West Virginia University.

President's Citation for Local Section Service to Richard Katz

The society recognizes Richard M. Katz for his many years of exemplary service serving in all officer positions with the Alabama section. We are especially grateful for Katz's devotion to arranging top-notch speakers for section meetings and for his work on programming for the annual Alabama Mining Institute.

Katz is a project engineer with Jim Walter Resources in Brookwood, AL. He is a member of the Coal & Energy Di-

vision and the SME Alabama Section and has been an active supporter of the section for many years. He has served in all of the officer positions and has become the, more or less, permanent secretary for the chapter. He coordinates meeting arrangements, obtains speakers and keeps the membership informed on what is going on at SME national.

Katz is an active volunteer with the Boy Scouts of America.

President's Citation to Gary Skaggs

"The society recognizes Gary Skaggs for his years of dedicated service on the Professional Engineers Exam Committee, including his service as the Professional Engineers Exam Representative to the SME Foundation Board of Trustees from 2006-2012."

Skaggs has more than 43 years of mining experience in underground domestic and international mining; 26 years for mining companies and 17 years in consulting. He has executive level management experience in integrating operating, technical and business functions; productivity, quality and safety improvements, conducting operational and safety audits; reserve and resource analysis; feasibility studies, and due diligence evaluation of mining enterprises. He is a licensed professional engineer in 13 states and the provinces of Alberta and Saskatchewan, Canada. He is a registered member of SME. Skaggs has served as a commissioner on the Engineering Accreditation Commission of ABET as SME's representative for mining engineering,

and as a mining engineering program evaluator. He has served on the SME Council of Education's Accreditation and Curricular Issues Subcommittee and the ABET Visitors Selection Committee. Skaggs received the 2009 Ivan B. Rahn Award. He is currently vice chair of the Colorado Plateau Section of SME and has chaired or co-chaired sessions for the Coal & Energy Division at annual meetings. He is also serving on the Resources and Reserves Committee and the Strategic Committee for Education and Professional Development.

Skaggs received a B.S. degree in mining engineering from Virginia Tech and an Executive M.B.A. from the University of Denver. In 2010, he received a distinguished alumnus award from the Virginia Tech Department of Mining and Mineral Engineering.



SKAGGS

Ivan B. Rahn Education Award to Richard Sweigard

The Ivan B. Rahn Education Award recognizes distinguished contributions to the educational activities within SME and is open to all SME members who have showed long-term interest in and have significantly contributed to SME activities relating to ABET, student affairs, continuing education, professional registration, or the Council of Education. The award is presented to Richard J. Sweigard "for his contributions to mining engineering education and his dedicated service to the educational mission of SME."

Sweigard has been the associate dean of engineering for administration and academic affairs at the University of Kentucky (UK) since 2007 and previously served for 14 years as chair of UK's Department of Mining Engineering. After completing his Ph.D. in mining engineering at The Pennsylvania State University, he spent four years as an assistant professor of mining engineering at Southern Illinois

University-Carbondale. During graduate school, he spent several summers at Consol Energy's Pittsburgh headquarters and at its Illinois surface operations.

Sweigard is currently chair of SME's Educational Sustainability Task Force, where he helped initiate the graduate student poster contest. After serving SME as an ABET program evaluator for several years, he is in his fifth year as an SME representative to ABET's Engineering Accreditation Commission, and he will begin a term on the Engineering Accreditation Commission's Executive Committee. He has served as chair of the Council of Education, chair of the Accreditation and Curricular Issues Committee, associate editor of the *Transactions of SME*



SWEIGARD

and on many technical committees. He serves on the National Research Council (NRC) Committee on Earth Resources and has participated in two NRC study panels that produced reports on coal slurry impoundments and place-

ment of coal combustion byproducts in surface mines. He also serves on the NIOSH Mining Sector Research Council. He is a licensed professional engineer in Pennsylvania and Kentucky.

Robert M. Dreyer Award to Dan Wood

The Dreyer Award recognizes outstanding achievements in applied economic geology, which must have been accomplished through commercial exploration or development



WOOD

of metalliferous and/or nonmetalliferous mineral deposits. The award is presented to **Dan Wood** “in recognition of his inspiring leadership, geologic insight, commercial acumen and measured persistence in mineral exploration that led to several significant and world class discoveries including the Crinum coking coal deposit in Queensland for BHP and both the giant Cadia/Ridgeway Cu-Au deposits in New South Wales and the Kencana/Toguraci bonanza epithermal gold deposits in Indonesia for Newcrest and for his (Dreyer) lecture.”

Wood is an exploration geologist and graduate from the University of Queensland, Australia. He retired from

corporate mineral exploration in 2008, after 24 years with BHP and almost 18 years with Newcrest Mining. From the mid-1990s, he led Newcrest’s exploration team as executive general manager, exploration. Newcrest was judged by the Metals Economics Group of Canada as the world’s most successful gold explorer from 1992-2005. The discoveries of the Newcrest’s exploration team laid the foundation for its transformation into a significant gold mining company.

Recently, Wood was director of the W.H. Bryan Mining and Geology Research Center at the University of Queensland, where he is an adjunct professor and member of the center’s advisory board. He is also a nonexecutive director of the Highlands Pacific Group, a resource industry ambassador for the State of Queensland and a Fellow of the Society of Economic Geologists. Wood is also a member of the Geological Society of Australia and a joint-recipient of its Joe Harms Medal for discovering the Cadia gold-copper deposits in New South Wales, Australia.

Syd S. Peng Ground Control in Mining Award to Bruce Hebblewhite

The Syd S. Peng Ground Control in Mining Award recognizes an individual or a group who has shown insight and understanding of ground control issues by developing concepts, theories, or technologies that have been adopted by the mining community; or has successfully implemented a ground control design or designs or practices. The award is presented to **Bruce Hebblewhite** “in recognition of his long and distinguished career conducting research, providing instruction and applying practical solutions in the field of ground control.”



HEBBLEWHITE

Hebblewhite graduated as a mining engineer from the University of New South Wales (UNSW), Australia in 1974. He earned a Ph.D. in mining rock mechanics from the University of Newcastle-upon-Tyne, UK in 1977. During this time, he also worked at the

Boulby Mine of Cleveland Potash Ltd in North Yorkshire, UK. He returned to Australia in 1977 and spent 17 years working for ACIRL Ltd, most recently as manager-mining division. He was responsible for consulting and applied research services to the Australian and international coal industries.

In 1995, Hebblewhite joined the School of Mining Engineering at UNSW as professor of rock mechanics and research director. He has been head of the school since 2003 and professor of mining engineering since 2007. From 2006 to 2009, in addition to his current position, he held the role of executive director, Mining Education Australia.

In his various UNSW roles, he has led the development of a number of new educational programs at the undergraduate and postgraduate levels, as well as a range of industry training and professional development programs. Since 2012, he has assumed the additional role of secretary general for the international Society of Mining Professors.

Outstanding Student Chapter Award to the University of Kentucky

The SME Outstanding Student Chapter Award is presented to the University of Kentucky in recognition of its outstanding achievements at the student chapter level.

The University of Kentucky’s Student Chapter activities have included participation in the Faces of Coal campaign at the Kentucky State Fair, freshman orientation weekend,

family weekend and Engineering Day. They have also provided many helpers in the tutoring program. The chapter supported the Kentucky Coal Association and the Kentucky Friends of Coal campaign, Coal Keeps the Lights On, at the school’s football and basketball games, and several students attended the “Stop the War on Coal” rally in Knott

County. Members of the chapter supported the Kentucky Coal Association's Kentucky Boy Scout coal camporee held on a reclaimed mine site.

A special highlight of the chapter's school year was the National Science Teachers Association conference in New Orleans, LA. The chapter sent three officers to assist in the distribution of mineral samples and mining information. Individual members also visited elementary and high schools to give presentations about careers in mining and its importance to our society. Chapter members participated in several community service activities: Coal Miners Care fundraising for fighting breast cancer, God's food pantry, and Kentucky Cares fundraising for local communities devastated by tornadoes.



Members of the University of Kentucky's SME Norwood Student Chapter.

MEC Visionary Award to Richard Beach

The Minerals Education Coalition (MEC) Visionary Award recognizes an individual SME member who has provided leadership to advance the mission of the MEC and has personally been involved in the delivery of its programs or activities. The award is presented to Richard A. Beach "for years of devoted time and personal effort toward educating children and adults about his love of geology and our benefits gained from mined products."

Beach is chair of the SME Colorado Section's MEC committee. He graduated from the Colorado School of Mines with a professional degree in geological engineering in 1966 and, after a time in graduate school, he served in the U.S. Army Corps of Engineers in Virginia and Vietnam.

Beach worked as a geologist and physical scientist for the U.S. Bureau of Mines (USBM) in Denver from 1972 until his retirement in 1994. At the USBM, he assessed

mineral resources on federal and Indian lands. He analyzed restraints on mineral exploration and development and applied them to statewide studies of federal mineral lands in several Rocky Mountain states.

Since retirement, Beach has continued his activities with SME, the Colorado Mining Association, the Colorado School of Mines Alumni Association, the Denver Mining Club and the Denver Region Exploration Geologists Society. He has been a volunteer and leader with the Boy Scouts for 35 years. As a member of the Colorado Section's MEC group, he makes many presentations about mining and minerals in Denver Metro area classrooms and at other venues.



BEACH

MEC Partnership Appreciation Award to the Mining Foundation of the Southwest

The MEC Partnership Appreciation Award is given to an SME nonmember or organization that has exemplified support for the MEC's mission either through development and use of educational materials with K-12 teachers and students or public outreach and awareness about mining and minerals. The award is presented to the Mining Foundation of the Southwest "in recognition of its support of mining education in the state of Arizona."

The Mining Foundation of the Southwest (MFSW) is a nonprofit organization working to ensure that the

public understands the importance of maintaining a strong and vibrant domestic and international mining industry. To achieve this goal, MFSW funds the position of outreach coordinator through the Lowell Institute for Mineral Research at the University of Arizona. The program focuses on how important mining is to our economy, our lifestyle and our quality of life. Pamela A.K. Wilkinson, a geologist and educator, gives presentations to middle and high schools, as well as civic organizations. Wilkinson taught more than 7,000 children in the 2010-2011 school year.

MEC Higher Education Campus Award to the University of Kentucky

The MEC Higher Education Campus Award is presented to the University of Kentucky "to recognize the outstanding efforts of its SME Student Chapter and its faculty

advisor for their accomplishments in community outreach and mining/mineral education to serve the mission of the MEC." See page 56-57.

Ben F. Dickerson Award to Thomas C. Patton

The Ben F. Dickerson Award is presented to Thomas C. Patton, P.G., to recognize his professionalism and contributions to the mining industry.

Patton received a B.A. from the College of Wooster and M.S. and Ph.D. degrees from the University of Washington. Early in his career he worked for Esso Eastern in West



PATTON

Germany and for Exxon Minerals in Tucson, AZ as exploration supervisor for the southwestern United States. Following nine years as a consulting geologist, he joined Kennecott as vice president of exploration and business development. The discovery of a cluster of economic kimberlite pipes at Lac de Gras, NWT, Canada, now in production, was a major accomplishment for the Kennecott exploration team.

After two years with Rio Tinto, Patton joined Western Silver of Vancouver, BC, Canada as president and

chief operating officer. This period was highlighted by the discovery and delineation of the world-class Peñasquito gold-silver-lead-zinc deposit in Zacatecas, Mexico and the subsequent sale of the company to Glamis Gold for \$1.2 billion.

Patton currently serves as the president and chief executive officer of Quaterra Resources, a junior exploration company with headquarters in Vancouver. Quaterra has made significant discoveries of uranium, gold, silver and copper and is currently focused on exploration and consolidation of the large Yerington, NV porphyry copper district and precious metal exploration in central Mexico with its strategic partner, Goldcorp.

The Howard L. Hartman Award to Keith G. Wallace



WALLACE

The Howard Hartman Award is presented to Keith G. Wallace Jr. in recognition of his distinguished contributions in practice, teaching or research in the field of underground ventilation engineering.

Wallace has 30 years of underground ventilation experience and is the president and chief executive officer of Mine Ventilation Services (MVS). He

received a B.S. in mineral engineering and an M.S. in mining engineering from the University of California, Berkeley. He began his career with MVS in 1982, which he founded in partnership with Malcolm McPherson.

Wallace has been a member of SME for 32 years and has served on the Executive Committee of SME's Un-

derground Ventilation Committee. He has published 30 papers on various aspects of mine ventilation and was the editor of the 12th U.S./North American Mine Ventilation Symposium held in Reno, NV in 2008. As a consulting engineer, he has worked on domestic and international projects for metal/nonmetal mines, coal mines, underground nuclear repositories and tunnel construction projects. His experience has included designs for nearly all types of mining methods, from block cave metal mines to longwall coal mines.

Wallace assisted McPherson in developing the VnetPC simulation program, a world recognized network simulation program. He has provided training to engineers through workshops that have tailored the concepts of ventilation to engineers at operations around the world. Wallace is a Fellow of the Mine Ventilation Society of South Africa.

Rock Mechanics Award to Mark Board



BOARD

The SME Rock Mechanics Award recognizes distinguished contributions to the advancement of the field of rock mechanics. The award is presented to Mark Board "in recognition of his successful application of rock mechanics principles to the understanding and solution of complex practical mining problems both in the U.S. and internationally."

Board is a rock mechanics engineer with 35 years of experience in the mining industry. He holds a Ph.D. degree in geological engineering from the University of Minnesota. His career began in 1975 as a mining engineer for Hecla Mining at the Star and Lucky Friday mines in northern Idaho. He worked for the Itasca Consulting Group, a mining-geotechnical consulting firm,

for about 25 years, performing ground control assessments and mine design studies worldwide. He has been involved in the assessment of rock burst potential and mitigation methods, including development of dynamic ground support methods, mine design procedures, preconditioning and fluid injection.

Since the mid-1980s, Board has been involved in the development and application of numerical modeling methods for underground and openpit design with particular application to prediction of caving and ground stability. Recent project involvement includes feasibility assessments for cave mine design at El Teniente, Chuquicamata and Cadia East as well as the future pit expansion at Bingham Canyon. He recently returned to Hecla Mining in Coeur d'Alene, ID, where he acts as the corporate geotechnical engineer.

Miner of the Year Award to Cherie M. Tilley

Miner of the Year Award recognizes mine site leaders who are able to manage production, people, community, safety and be good stewards of the environment. The award

is presented to Cherie M. Tilley "for being the perfect example of the true 'Miner of the Year' and for being the man who has participated in all phases of the minerals industry,

putting the rock in the box and keeping safety a top priority.”

Tilley was born at Anaconda’s Rio Tinto mining camp in Nevada and raised at Anaconda’s Darwin mining camp in California. He has 54 years of underground mining experience and has been in mine management for the last 37 years. He worked for Gulf Mineral Resources as general mine superintendent at the Mariano Lake Mine and as development superintendent at the Mount Taylor Mine. He was the development manager for Phillips Uranium at the Nose Rock Project and mine development director in Denver, CO. Also in Denver, he was vice president-mining for American Mine Services.

Tilley joined Chevron Mineral Resources in Montana and became the mine manager at the Stillwater Mine. He then worked for Dynatec Mining as project manager, safety director and area manager.

Tilley has written and presented eight papers for SME and co-authored a ninth. In 1983, he was published in *Tunnels and Tunnelling*. He made presentations at the Colorado School of Mines Mechanical Mining Seminar in 1989, the Northwest Mining Association Short Course in 1990 and presented a paper for the 1990 International Society of Explosive Engineers Conference in Lewiston, MT. He received the 1994 Award of Merit from the Underground Space Association.

Tilley is now retired from Dynatec Mining and is a mining consultant doing business as Tilley Exploration and Development.



TILLEY

Mining & Exploration Division Distinguished Service Award to William A. Warfield

The Mining & Exploration (M&E) Division Distinguished Service Award is presented to William A. Warfield in recognition of his significant contributions to the workings of SME and the Mining & Exploration Division and his outstanding reputation for professionalism and accomplishments.

Warfield began his involvement with SME as president of the student chapter at the Colorado School of Mines (CSM). He served as chair of the Pacific Southwest Region from 2001-2002 and was active with the San Francisco and the Sierra Nevada local sections, having worked through the chairs to serve as president of each. He helped draft the bylaws combining the two sections to form the present Northern California Section, where he currently serves on the Scholarship Committee.

Warfield is past chair of the M&E Division. During his tenure, the division created the Miner of the Year Award to recognize leaders working on the mine sites that are

able to manage production, people, community, safety and be good stewards of the environment.

Warfield served on the original Aggregates and Construction Materials Committee and helped draft new bylaws to combine the Industrial Minerals Division and Aggregates Committee to form the new Industrial Minerals & Aggregates Division of SME.

Warfield is business development manager, geologic drilling and exploration, for Atlas Copco CMT. He has held the positions of product manager-ground engineering products and western U.S. regional sales manager-consumables. He joined Atlas Copco after it acquired the Drilling Solution Division of Ingersoll-Rand (IR) in 2004. While with IR, he was responsible for mining, quarry and D&B customers in northern California.



WARFIELD

Mining & Exploration Division Outstanding Young Professional Award to Elaina M. Ware

The Mining & Exploration Division Outstanding Young Professional Award is presented to Elaina M. Ware in recognition of her meritorious accomplishments working in the mining and exploration industry.

Ware has nearly 15 years of experience in mining, including openpit metals, minerals and coal. She is currently the mine operations manager at Rio Tinto’s Kennecott Utah Copper and is responsible for the management of more than 700 employees at the Bingham Canyon Mine in Salt Lake City, UT. Her previous roles with Rio Tinto include manager of mine technical services at Kennecott Utah Copper; medium-range planner and mine technical services manager at its surface borate mine in California; mining engineer at the Antelope Mine, a surface coal mine

in Wyoming, and production planner, haul-truck operator and business improvement facilitator at Cordero Rojo, a surface coal mine in Wyoming.

Prior to joining Rio Tinto, Ware was a reclamation engineer, dragline engineer, scheduler and project engineer with the Kiewit Mining Group. She is a professional engineer in the state of Utah.

Ware held several leadership roles in the University of Missouri-Rolla’s SME Student Chapter during her collegiate career. She graduated magna cum laude with a B.S. in mining engineering in 1999.



WARE

Coal & Energy Division Distinguished Service Award to Jürgen F. Brune



BRUNE

The Coal & Energy Division Distinguished Service Award is presented to Jürgen F. Brune to recognize his achievements in the coal-mining industry.

Brune is a research professor at the Colorado School of Mines (CSM), where he received his master's degree in mining engineering in 1983. He received his undergraduate as well as his doctorate in mining engineering from the Technical University of Clausthal in Germany.

Brune started his career in the surface lignite mines

in Germany, where he was a production foreman, slope-stability engineer and planning manager. In 1992, he joined Consol Energy as a ventilation engineer, assistant mine superintendent and manager of engineering services.

In 2004, Brune joined the National Institute for Occupational Safety and Health (NIOSH) where he conducted and managed research in mine ventilation and fire and explosion prevention. In 2007, he was appointed director of the NIOSH Spokane Research Laboratory. Brune joined CSM in 2012 and focuses his research and teaching on coal mining, mine ventilation and, specifically, mine fire and explosion prevention.

J.W. Woomer Young Engineer Award to Kramer Luxbacher



LUXBACHER

The J.W. Woomer Young Engineer Award recognizes the engineering professionalism of young people working in the coal industry. The award is presented to Kramer Luxbacher "for her contributions in mining health and safety as a result of innovative research, technology development, teaching excellence and professional service."

Luxbacher is assistant professor of mining engineering at Virginia Tech, where she joined the faculty of the Mining and Minerals Department in 2008. She received her Ph.D. (2008), M.S. (2005), and B.S. (2002) degrees, all in mining engineering, from Virginia Tech. Prior to pursuing her graduate studies, she worked as an industrial engineer and underground production foreman for Consol Energy. She is a registered professional engineer in Virginia and has held certification as

an underground coal mine foreman. Her primary research interests are in underground mine ventilation, mine health and safety and coalbed methane extraction.

Luxbacher is also involved in research projects totaling more than \$3 million funded by the National Institute for Occupational Safety and Health, industry and the U.S. Environmental Protection Agency. She advises seven graduate students and has published more than 20 peer-reviewed journal papers and conference proceedings and 10 other publications. In 2011, she received Virginia Tech's Dean's Award for Outstanding New Assistant Professor.

Luxbacher was a member the SME Student Chapter at Virginia Tech. She currently serves as an officer of the Underground Ventilation Unit Committee and a member of the Education & Professional Development Strategic Committee. She is also a member of the Society of Petroleum Engineers, the American Society for Engineering Education and the Society of Mining Professors.

Stefanko Best Paper Award to Andrew Cecala, James Noll and John Organiscak

The Stefanko Award recognizes authors presenting papers in the Coal & Energy Division technical sessions for their contributions to the body of knowledge. The award is presented to Andrew B. Cecala, James Noll and John Organiscak for their paper "Long-Term Evaluation of Cab Particulate Filtration and Pressurization Performance."



CECALA

Andrew Cecala is a mining engineer with the Office of Mine Safety and Health Research for the National Institute for Occupational Safety and Health (NIOSH) in Pittsburgh, PA, and has worked in health and safety research for 32 years. He earned a B.S. in mining engineering from West Virginia University in 1980 and an M.B.A. from Duquesne University in 1989. He has written more than 125 publications, 95 of which he has been the primary author. His career has been focused on reducing workers' respirable dust

exposures throughout the mining industry. Recently, he co-chaired and published a multiyear effort between NIOSH and the Industrial Minerals Association-North America to produce the *Dust Control Handbook for Industrial Minerals Mining and Processing*. This handbook describes the dust-generating processes and the control strategies necessary to reduce workers' dust exposure.

Cecala has also been working with the mining industry, original equipment manufacturers and manufacturing companies to optimize filtration and pressurization systems for enclosed cabs on mobile mining equipment in an effort to minimize workers' exposures to respirable dust and other contaminants. He was instrumental in the design and testing of the clothes-cleaning-booth technology. He is also involved in the Helmet-CAM project, a wearable video recording system.

James Noll graduated from Thiel College in 1991 with a B.A. in chemistry. He received a Ph.D. in analytical chemistry from the University of South Carolina in 1996. He has

worked in the field of analytical and physical chemistry for more than 15 years in industry and government.

Noll is currently a research chemist with NIOSH, where his primary areas of research include measurement and control of health hazards in mines. He has done extensive research in the development of measurement techniques for diesel particulate matter (DPM), including developing a real-time monitor. He has also investigated measurement techniques for silica and dust.

Noll's research emphasis includes evaluating and developing techniques for controlling DPM and dust exposures. One part of this research focuses on the evaluation of filtration and pressurization systems, such as in enclosed cabs, to assess their effectiveness at reducing dust and DPM concentrations. In addition, the implementation of ventilation, administrative controls, diesel particulate filters and alternative fuels in underground mines for controlling DPM and dust has been part of his research effort.

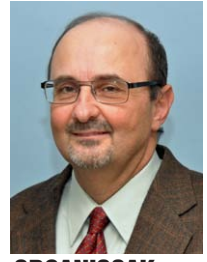
John Organiscak is a mining engineer with the Office of Mine Safety and Health Research at NIOSH. He earned



NOLL

his B.S. in mining engineering from The Pennsylvania State University in 1980 and an M.B.A. from Duquesne University in 1990. He started his research career with the U.S. Bureau of Mines in 1981 and was transferred to NIOSH when the bureau closed in 1996. He has been involved primarily in dust control and ventilation research in underground and surface mining operations throughout his career. He has authored and co-authored more than 90 technical research papers.

Some of Organiscak's most recent accomplishments have been the development of a mathematical model for quantifying cab filtration system performance and the co-development of a new patented cab filtration system air leakage measurement method with a filter manufacturer. He is currently studying scrubber exhaust configurations for optimizing respirable dust control at continuous miner sections. He also serves on an American Society for Agricultural and Biological Engineers committee, which is developing agricultural consensus standards for air-quality systems for cabs used on tractors and self-propelled machinery.



ORGANISCAK

Environmental Division Distinguished Service Award to Robert Reisinger

The Environmental Division Distinguished Service Award is presented to Robert Reisinger. The award recognizes division members who have significantly contributed to the workings of SME and the Environmental Division and have an outstanding reputation for professionalism and accomplishment.

Reisinger is a senior project manager with CH2MHill in Denver, CO. He has 32 years experience providing mining and environmental engineering services to mining sites through the world, with particular emphasis on mine closure and reclamation. Reisinger has significant experience in performing environmental assessments, environmental audits and environmental impact statements related to the global mining industry. Reisinger received his M.S. in environmental sciences and engineering from the Colorado School of Mines and a B.S. in mining engineering from the University

of Wisconsin-Platteville. He has been a member of SME for more than 36 years and has served on the Environmental Division Executive Committee for the past four years and has served on numerous division committees. He has also served as a member of Professional Engineers Exam Committee, as chair of the Rocky Mountain Region and as chair of the Environmental Program Session.

Reisinger is currently a member of the SME Distinguished Member Nominating Committee, the ad hoc Mine Operators Committee, the Information Publishing Committee and the *Mining Engineering* Committee. He coordinated a short course on risk-based mine closure planning at the 2008 SME Annual Meeting in Salt Lake City, UT.



REISINGER

A. Frank Alsobrook Industrial Minerals & Aggregates Division Distinguished Service Award to Robert Pruett

The A. Frank Alsobrook Industrial Minerals & Aggregates Distinguished Service Award is presented to Robert J. Pruett in recognition of his significant contributions to the workings of SME and the Industrial Minerals & Aggregates Division and his outstanding reputation for professionalism and accomplishments.

Pruett is the minerals technology director for Imerys-Pigments Paper and Packaging Group, in Sandersville, GA. He joined the Georgia Kaolin research department in 1990 as a senior research scientist and acting group leader

for the analytical laboratories. ECC International (ECCI) acquired Georgia Kaolin in 1991. He became leader of the Minerals Technology Department in 1996, and he continued in a similar role when Imerys purchased ECCI in 1999.

Pruett received a B.S. in geology and geophysics from the University of Wisconsin and earned a Ph.D. and



PRUETT

M.S. in geological sciences from Indiana University. His research has focused on the geology, mineralogy, properties, processing and uses of kaolin and pigment minerals. He has written more than 17 peer-reviewed papers and is listed as an inventor on more than 13 patents.

Pruett is a past chair of the Industrial Minerals Division, a past member of the SME Board of Directors and has served on many SME and IM&AD committees in the ca-

capacity of chair or member. He is currently the membership representative on the IM&AD Executive Committee and program chair for the Georgia Local Section. He received the Gerald V. Henderson Jr. Industrial Minerals Scholarship in 1996, the division's Young Scientist Award in 1995, the Robert W. Piekarz Award in 2002 and was a member of the 1998 Future Leaders program (now the Young Leaders Committee).

Industrial Minerals & Aggregates Division Young Scientist Award to Vishal Gupta



GUPTA

The Industrial Minerals & Aggregates Division Young Scientist Award is presented to Vishal Gupta in recognition of his scientific professionalism working in the industrial minerals and aggregates industry.

Gupta is currently working as research engineer in the research and development department of FLSmidth in Salt Lake City, UT. He received a Ph.D. in metallurgical engineering from the

University of Utah in 2010. He also received an M.S. from Southern Illinois University and a B.Tech with honors de-

gree from the Indian School of Mines.

Gupta is an SME Henry Krumb lecturer for 2012-2013. He has more than seven years of academic and four years of industry research experience working in the surface chemistry of minerals. This includes clay minerals, such as kaolinite and trona, and other sulfide minerals flotation, coal processing and optimization, mineral beneficiation, and bacteria and nanoparticles transport. Gupta has also made creative and innovative efforts in minerals beneficiation, such as coal washability, magnetic separation, flotation and tailings treatment. He has received one patent, published 12 journal articles, one book, one book chapter and presented his work at national and international technical conferences.

Antoine M. Gaudin Award to Graeme Jameson



JAMESON

The Antoine M. Gaudin Award recognizes scientific or engineering contributions that further the understanding of the technology of mineral processing. The award is presented to Graeme Jameson "for outstanding contributions to hydrodynamics of flotation and its role in fine and coarse particle flotation at both the engineering science and industrial technology levels."

Jameson received a B.S. degree from the University of New South Wales, Australia, and a Ph.D. from the University of Cambridge, United Kingdom. After several years in the research laboratories of Standard Oil of California, in 1965 he joined the chemical engineering department at the Imperial College London, where he stayed until 1978. Currently, he is the laureate professor and direc-

tor of the Center for Multiphase Processes at the University of Newcastle in Australia.

In 1969, Jameson began a series of investigations into fluid dynamical aspects of flotation that continues to the present day. His work has resulted in many publications and patents, as well as memberships in learned academies and prizes and awards, both national and international. His early work showed the importance of small bubbles in flotation, so he looked for practical new ways of making such bubbles in the large volumes needed for flotation. This work led to the Jameson Cell, which is in use in 25 countries for the treatment of sulphide minerals, coal, oil sands and SX/EW liquors.

Currently, Jameson is working on new ways to improve the recovery of coarse particles by flotation.

The Antoine M. Gaudin Award is funded by Barrick Gold North America.

Milton E. Wadsworth Award to Jan D. Miller



MILLER

The Milton E. Wadsworth Award recognizes distinguished contributions that advance our understanding of the science and technology of nonferrous chemical metallurgy. The award is presented to Jan D. Miller "for outstanding contributions to the fundamental theory and technology of hydrometallurgy."

Miller is the department chair and Ivor Thomas Distinguished Professor

of Metallurgical Engineering, College of Mines and Earth Sciences, University of Utah. He received his B.S. degree, graduating with distinction, from The Pennsylvania State University. His M.S. and Ph.D. degrees in metallurgical engineering were earned at the Colorado School of Mines. He has received numerous awards based on research contributions in mineral processing and hydrometallurgy, he has authored more than 500 publications and has served on the faculty at the University of Utah for 44 years.

Miller is a member of the National Academy of Engi-

neering and a Distinguished Member of SME. He received honorary Ph.D. degrees from the University of Pretoria in South Africa and from the Gdansk University of Technology in Poland. In addition, he has honorary professorial ap-

pointments from several universities in China and from the Chinese Academy of Sciences.

The Milton E. Wadsworth Award is funded by Freeport-McMoRan Copper & Gold Inc.

Arthur F. Taggart Award to Glenn Hoffman and S. Jayson Ripke

The Taggart Award recognizes a paper published in the last 18 months that represents the most notable contribution to the science of mineral processing. The award is presented to Glenn E. Hoffman and S. Jayson Ripke for their paper, "New Approach to Developing the Optimal Mineral Processing Flowsheet," published in *Mining Engineering*, March 2012.

Hoffman is president and chief executive officer (CEO) of Cardero Iron Ore Management. During the last six years, he has directed the work related to developing the various iron ore assets owned by the Cardero Group, as well as directing the technology effort for the North Atlantic Iron's joint venture iron sands project.

Hoffman worked for 30 years at Midrex Technologies as a process development engineer and manager of research and development projects, such as exotic combustion technologies, natural gas and coal-based direct reduction technologies for iron ore and new, iron making technologies. These included HIs melt, Fastmet, Fastmelt and ITmk3.

Hoffman has a B.S. in metallurgical and materials engineering from the Illinois Institute of Technology and an M.S. in metallurgical engineering from Michigan Technological University. He is a metallurgy/processing qualified professional through the Mining & Metallurgical Society of America. He served as an SME Henry Krumb lecturer

award and received the A.M. Gaudin award. He also holds 16 U.S. patents.

Ripke is vice president technical for Cardero Iron ore. He has extensive experience working as the pellet plant process engineer at the Northshore Mine in Minnesota owned by Cliffs Natural Resources and as chief metallurgist at its Wabush Mine in Labrador, Canada. More recently, he was the new technology manager and plant sales manager for Midrex Technologies.

Ripke joined Cardero in 2008 to head up pelletizing work at Pampa de Pongo. He was instrumental in developing the Cardero Materials Testing Laboratory, which is used to develop flowsheets for projects in Ghana, Minnesota, Peru, Europe, Asia and Canada, as well as for other companies' projects. He earned a B.S. and M.S. in metallurgical and materials engineering and a Ph.D. in chemical engineering, all from the Michigan Technological University.

The Arthur F. Taggart Award is funded by Resource Development Inc.



HOFFMAN



RIPKE

Mineral & Metallurgical Processing Division Outstanding Young Engineer Award to Lisa Schlink

The Mineral & Metallurgical Processing Division (MPD) Outstanding Young Engineer Award is presented to Lisa Schlink in recognition of her significant contributions within the mineral processing and extractive metallurgy disciplines.

Schlink is the chief engineer for Freeport-McMoRan Copper & Gold's water treatment test facility. She currently oversees the commissioning and operation of three water treatment test plants.

Schlink joined the U.S. Army after high school and served as an unmanned aerial vehicle operator at Ft. Huachuca, AZ. She received a B.S. in metallurgical and materials engineering and science from the South Dakota School of Mines & Technology (SDSM&T) and served as secretary and vice president of the SME student chapter. She received an M.S. in nanotechnology from SDSM&T in 2007.

Schlink began her career with Freeport-McMoRan in 2006 as a metallurgist II at the Chino Mine in New Mexico. From Chino, she transferred to Tohono to oversee the

leaching, solvent extraction and electrowinning activities of a residual leach operation. She eventually coordinated the mothball activities of the mine and developed a solution management plan to reduce and manage the remaining process waters. She was then selected to manage the commissioning and operation of Freeport's water treatment test facility at the Sierrita Mine in Arizona.

Schlink served as secretary/treasurer for the Southwestern New Mexico Section and joined the Young Leaders Committee in 2007. As a Young Leader, she participated in the mentor program, the Member Selection Committee, developed an alumni directory, organized technical sessions and served as secretary. She was a judge of the 2012 MPD Student Poster Contest.

The MPD Outstanding Young Engineer Award is funded by Hazen Research.



SCHLINK



AIME Awards

Howard W. Eavenson Award to Pramod Thakur



THAKUR

The Howard W. Eavenson Award recognizes distinguished contributions to the advancement of coal mining. The award is presented to Pramod C. Thakur “for his distinguished contributions to the advancement of coal mine safety through research, innovative techniques for methane degasification and for his lifetime endeavors in minimizing the risk of coal mine explosions worldwide.”

Thakur is the manager of the Coal Degasification Group for Consol Energy. He has been with Consol for the past 38 years. He is also an adjunct professor at West Virginia University, where he teaches reservoir and production engineering for coalbed methane, and is the president of the board for the North American Coalbed Methane Forum. He holds six U.S. patents.

Thakur received his undergraduate degrees in mining engineering from the Indian School of Mines. He moved to the United States in 1969 and earned an M.S. and a Ph.D.

in mining engineering from Penn State. In 1974, he joined Conoco and conducted exhaustive research on coal seam degasification, respirable dust control and diesel exhaust control. He successfully managed research projects that led to the development and application of four different techniques for coal seam degasification.

In 1997, Thakur was appointed a commissioner by the governor of West Virginia to write regulations and approve diesel engines for use in coal mines, replacing trolley wire haulage. He also developed new ways to improve dust control by water infusion, the use of surfactants and electrostatic charging of water particles.

Thakur has published about 50 peer-reviewed technical papers and wrote a book on solving mine-network problems analytically. He contributed chapters to *Mine Ventilation and Air Conditioning* by Howard Hartman and the *SME Mining Engineering Handbook* (2011). He received the Hartman Award in 2004 for his contributions to mine ventilation engineering and promoting coal mine health and safety.

Erskine Ramsay Medal to Michael Karmis



KARMIS

The Erskine Ramsay Medal recognizes distinguished achievement in coal mining, including bituminous coal and anthracite. The medal is presented to Michael Karmis “for his contributions to mining engineering, mine health and safety, the improvement of environmental performance of coal mining and for his international recognition as a teacher, researcher and academic leader.”

Karmis is the Stonie Barker Professor in the Department of Mining and Minerals Engineering and the director of the Virginia Center for Coal and Energy Research at Virginia Tech. His expertise is in the areas of mine health and safety, rock mechanics and ground control, mining systems and the sustainable development of energy and mineral resources. He has authored or co-authored more than 160 scientific papers and has directed 60 major

research projects funded by federal and state agencies, foundations and private companies.

Karmis is a recognized teacher, graduate advisor and student mentor and has received numerous certificates of teaching excellence and other teaching commendations. He is a licensed, professional engineer and an active consultant to the mining industry, academic and research institutions, government agencies, engineering companies, and financial and legal firms. He served as the 2002 president of SME and as the 2009 president of AIME. He currently serves as a trustee and vice president of the United Engineering Foundation. He was elected as the 2002 President of the Society of Mining Professors (Societät der Bergbaukunde) and served as its secretary general from 2005 to 2012.

Karmis is an Honorary Member of AIME, a Distinguished Member of SME, a Fellow of the Institute of Quarrying and a Fellow of the Institute of Materials, Minerals and Mining.

Hal Williams Hardinge Award to Sarkis Ampian

The Hal Williams Hardinge Award recognizes outstanding achievement in the field of industrial minerals. The award is presented to Sarkis Ampian “for service to the Industrial Minerals & Aggregates Division (IM&AD) and the industrial minerals industry in the characterization and regulation of clays and other industrial minerals.”

Ampian is an industrial minerals consultant and geo-

chemist. He retired from the U.S. Bureau of Mines after nearly 40 years of service in the bureau’s research and commodity groups. The commodity group work centered on monitoring all domestic and offshore clay, oil shale, zircon, barium and strontium, and drilling-mud activities. He also served as the principal mineralogist in the bureau’s outreach to all federal, state and international regulatory

agencies, publishing and lecturing for the Department of Interior on policies relating to asbestos and crystalline silica and to locatable clay minerals.

Ampian has been an SME member for nearly 40 years. He was the chair of the Industrial Minerals Division in 1995, a member of the SME Board of Directors and served on many division committees. He received the IM&AD A. Frank Alsobrook Distinguished Service Award and is a frequent speaker and session chair at SME annual meetings.

Currently, Ampian is an asbestos and crystalline silica consultant. As a member of the National Academy of Science's Mineralogy Committee, he has reviewed National Institute for Occupational Safety and Health's proposed 2008/2009 document "Asbestos Fibers and Other Elongated Mineral Particles: State of the Science and Roadmap for Research."



AMPIAN

Daniel C. Jackling Award to Edward C. Dowling

The Daniel C. Jackling Award recognizes significant contributions to technical progress in mining, geology and geophysics. The award is presented to Edward C. Dowling "for his exceptional ability in the creation, design and operation of mines and for demonstrating the courage and pioneering spirit to advance the interests of mining across the globe."

Dowling is currently a director of Alacer Gold and Victoria Gold and has served on the boards of Anatolia Minerals and Meridian Gold. He was elected to the board of directors of Teck, a diversified resource company, in September 2012. He is the former president and chief executive officer (CEO) of Alacer Gold Corp., a position from which he retired in July 2012.

Other leadership roles held throughout his 30-year career in the mining industry include president and CEO of Anatolia Minerals Development; president and CEO of Meridian Gold; executive director, mining and exploration for De Beers in Johannesburg, South Africa and executive vice president, operations for Cleveland-Cliffs. He also served in a variety of leadership positions at Cyprus Amax Minerals.

Dowling received a B.S. in mining engineering and an M.S. and a Ph.D. in mineral processing from The Pennsylvania State University.



DOWLING

Robert M. Peele Memorial Award to Ananta L. Yennamani

Ananta L. Yennamani is the recipient of the Robert M. Peele Memorial Award for the paper "Blast-Induced Rock Movement Measurement for Grade Control" by A. Yennamani, S. Aguirre and P. Mousset-Jones, published in *Mining Engineering* magazine in 2011. The award recognizes the most outstanding paper published on behalf of the Mining & Exploration Division by an SME member-lead author under the age of 35.

Yennamani received a diploma in civil engineering in 2004 and a B.S. in civil engineering in 2007. In 2008, she attended University of Nevada, Reno (UNR) and received a M.S. in mining engineering. Her thesis project was on blast movement measurement for grade control, which she

worked on while she was an intern at the Phoenix Mine. She also worked as a research assistant at the university. She received the UNR outstanding student award for 2010. Yennamani began working for AMEC in 2011 as a mining engineer. She supports senior staff members on projects and mining engineering protocols, prepares plans and reports with related engineering calculations, develops the specifications required to improve the results and provides support to various mining and geology projects.



YENNAMANI

William L. Saunders Gold Medal to Ronald W. Thiessen

The William L. Saunders Gold Medal is presented to Ron Thiessen "for his inspiration and transference of corporate values, instilling a philosophy that strives for responsible and ethical development of minerals, the respectful treatment of stakeholders, maximizing shareholder value, and best management practices in corporate governance, while creating a working environment that is fulfilling to

employees." The award recognizes distinguished achievement in mining other than coal. The term "mining" includes the production of metals as well as nonmetallic minerals.

Since the 1980s, Thiessen has concentrated on the management and financing of public and private companies. He joined Hunter Dickinson Inc. (HDI), a Canadian corporation, in 1996 as director of corporate development and, in


THIESSEN

addition, became chief executive officer in 2000. Since 1985, HDI has grown to be among the largest and most successful mine development groups in North America. He and his associates have completed in excess of 25 property or project acquisitions, raised more than \$1.4 billion in equity financings and built an impressive portfolio of advanced mineral exploration, development and mining projects.

Thiessen and the HDI principals won the Pacific Ernst

& Young Entrepreneur of the Year award in 2004. He and the Northern Dynasty team won the Thayer Lindsley International Discovery Award from the Prospectors and Developers Association of Canada for the Pebble East deposit discovery in 2007.

Thiessen received the E.A. Scholz Award from the Association for Mineral Exploration British Columbia for excellence in mine development in 2008 and was named the Business Person of the Year by the Canada-Southern Africa Chamber of Business in 2011. He holds a bachelor of commerce degree from the University of Saskatchewan and a chartered accountant designation.

Robert H. Richards Award to Nick Hazen


HAZEN

The Robert H. Richards Award recognizes achievement in any form, which unmistakably furthers the art of mineral beneficiation in any of its branches. The award is presented to Nick Hazen “for his contributions in the development of innovative and commercially effective metal extraction process flowsheets, and his leadership role in growing and enhancing Hazen Research Inc. as a global leader in metallurgical testing, research and development.”

Hazen is president and chief executive officer of Hazen Research, an employee-owned company that was founded by his father and grandfather in 1961. The company has grown from a single-building laboratory to the largest private metallurgical and processing research and development (R&D) facility in the United States and serves clients around the world.

During his tenure at Hazen, the company has played a

vital role in developing several key processes in the metallurgical industry. Processes developed under his direct technical leadership include pressure leaching and recovery of molybdenum from sulfide concentrates, pressure oxidation and recovery of copper from sulfide concentrates, copper and cobalt recovery from African copper belt ores, and copper direct electrowinning technology. All of these processes were taken from R&D through piloting to effective full-scale commercial production.

Hazen received a B.S. in chemical engineering from the University of Colorado in 1980. He received the 2008 Arthur F. Taggart Award, the 2012 Futers Gold Medal and has been awarded 30 patents.

Hazen enjoys transferring knowledge from research into industrial applications and believes that, while a metallurgical problem may be complex and require bringing together many disciplines, the outcome must be simple to be successful in an operating plant.

The Robert H. Richards Award is funded by BHP Billiton Base Metals.

Charles F. Rand Memorial Gold Medal to Arthur Schweizer


SCHWEIZER

The Charles F. Rand Memorial Gold Medal recognizes distinguished achievement in mining administration. The medal is presented to Arthur Schweizer “for his business acumen, willingness to challenge the status quo and inspirational leadership in overcoming seemingly intractable problems to address the needs of the minerals sector.”

Schweizer graduated from the Missouri University of Science & Technology (MS&T) with a B.S. in metallurgical engineering. In 2000, he received a professional degree from MS&T’s metallurgical department for career achievements and success.

For the past 12 years, Schweizer has been the president and owner of Green Diamond Sand Products. He has focused his efforts toward development and growth, and the

company has increased its yearly production from 45 mt (50,000 st) of abrasives to more than 272 mt (300,000 st) of more than 40 varieties of industrial minerals products.

Schweizer has also played an important part in promoting mining education in elementary and high school curricula in the state of Oregon. He has been involved in publishing professional papers and books, and he was the chair of the National Science Teachers Association meetings in Portland, OR in 2002 and 2008.

Schweizer has also been involved in many community projects. He was actively involved in developing children’s soccer programs and has been a member of the Optimist Club, Elks Club and Chamber of Commerce. Schweizer has always been involved with SME on the local and national levels. He has held many positions on various committees and was SME President in 2004. He is currently a member of the SME Foundation Board of Trustees.

Frank F. Aplan Award to Barbara Arnold

The Frank F. Aplan Award recognizes engineering or scientific contributions that further the understanding of the technology of coal or mineral engineering. The award is presented to Barbara Arnold for “her R&D contributions and accomplishments in all facets of coal processing, particularly froth flotation, computer simulation, flowsheet development and plant evaluation.”

Arnold is currently president of PrepTech in Apollo, PA. She holds B.S., M.S. and Ph.D. degrees in mineral processing from The Pennsylvania State University, where she specialized in coal froth flotation, fine particle processing and coal petrology. Her research and development experience has included projects for government and industry funding agencies, as well as for private companies. She has worked on the development of a coal-cleaning simulator, coal handling, coal blending, coal-cleaning characterizations and flowsheet evaluations. Her project management experience has included the development and management of

project budgets, project schedules, oversight of project personnel and reporting functions.

Arnold has published more than 50 technical papers and reports and given technical presentations at industry conferences and meetings in the United States and abroad. She received the Coal & Energy Division’s Young Engineer award, the division’s Distinguished Service Award and was chosen an SME Distinguished Member in 2006. She also received the 2007 Robert Stefanko Distinguished Achievement Award in mineral engineering from Penn State. She is a registered professional engineer in Pennsylvania. Arnold is currently president of the SME Foundation Board of Trustees and a member of its 1K Club and has served on the SME Education & Professional Development Strategic Committee.



ARNOLD

AIME Honorary Membership to Nikhil Trivedi

AIME Honorary Membership is awarded in appreciation of outstanding service to the Institute or in recognition of distinguished scientific or engineering achievement in the fields embracing the activities of AIME. AIME Honorary Membership is given to Nikhil Trivedi “for 40 years of exceptional contributions to SME including his service as president and board member and for his contributions to industry, especially in the industrial minerals sector.”

Trivedi has a B.S. degree in chemistry and geology from the University of Bombay, India, an M.S. degree in metallurgy and mineral economics from the Mackay School of Mines, University of Nevada-Reno, and a Ph.D. in chemical engineering and microbiology from the University of Minnesota. For 30 years, Trivedi worked for Pfizer’s Minerals Division, which is now known as Minerals Technologies Inc. His last position there was chief technology officer. After his retirement in 2004, he founded Idekin International, an industrial minerals consultancy. He is a senior partner at Idekin.

Trivedi has served on the SME Executive Committee, Nominating Committee and the Governance and Organization Strategic Committee. He has served as the SME Program Chair (1993) and on SME Board of Directors from 1993-1997 and from 2006-2008. He was president of SME in 2010. He is currently SME’s representative on AIME’s Board of Trustees.

Trivedi became a Distinguished Member of SME in 1998. He received the IM&AD Distinguished Service Award and the Harding Award. He also received the 1995 John William Mackay Outstanding Alumni Award from the Mackay School of Mines. The SME Foundation has honored him with the John T. Boyd Challenge plaque. He received the SME Presidential Citation in 2007. He was a senior editor of the seventh edition of SME’s *Industrial Minerals and Rocks*.



TRIVEDI

James Douglas Gold Medal to Patrick R. Taylor

The James Douglas Gold Medal recognizes distinguished achievement in nonferrous metallurgy, including both the beneficiation of ores and the alloying and utilization of nonferrous metals. The medal is presented to Patrick R. Taylor, P.E., “for his distinguished career contributions and accomplishments in mineral processing and extractive metallurgy and their application in waste treatment, recycling and reactor design.

Taylor has more than 38 years of experience in mineral processing and extractive metallurgy engineering, research, teaching and consulting. He is currently the George S. Ansell Distinguished Professor of Chemical Metallurgy at the Colorado School of Mines (CSM). He is also the direc-

tor of the Kroll Institute for Extractive Metallurgy. He has supervised research for more than 80 graduate students and post-doctoral researchers. He received his Ph.D. in metallurgical engineering from CSM in 1978. He has authored or co-authored 200 papers and presentations and holds eight patents. He has served as a director of three publicly traded mining companies and has owned a private testing and consulting engineering business for 20 years. He has served as a consultant for more than 20 companies and been an expert witness.



TAYLOR

Taylor was named Distinguished Faculty Member at the University of Idaho in 1990, and in 1994 he received university's Research Excellence Award. In 1996, he was named a Fellow of ASM International. He received the 2003 Wad-

sworth Award from SME and was named a Distinguished Member in 2008. In 2006, he was the TMS Extraction and Processing Division Distinguished Lecturer and received the TMS EPD Distinguished Service Award in 2010.

AIME Mineral Economics Award to Roussos Dimitrakapoulos



DIMITRAKAPOLOUS

The AIME Mineral Economics award recognizes distinguished contributions in the advancement of mineral economics. The award is presented to Roussos Dimitrakapoulos, "a world-class mining engineer and scientist who has successfully demonstrated that stochastic mine-planning techniques substantially increase the value of a mineral deposit."

Dimitrakapoulos is currently professor and the Canada research chair (Tier I) in Sustainable Mineral Resource Development and Optimization under Uncertainty and director of the COSMO laboratory at McGill University, Montreal, PQ, Canada. Previously he was full professor and director of the Bryan Research Center at

the University of Queensland, Australia. He holds a Ph.D. from Ecole Polytechnique, Montreal and an M.S. from the University of Alberta, Edmonton, AB, Canada.

Dimitrakapoulos has been working in deposit risk analysis since 1983 and, more recently, on stochastic optimization for mine design, production scheduling and valuation. Recent interests and work include modeling aspects of geologic CO₂ sequestration. He has been the senior geostatistician with Newmont Mining Corp., Denver, CO and senior consultant with Geostat Systems. He has taught and worked in Australia, North America, South America, Europe, the Middle East, South Africa and Japan. He was elected Fellow of the Southern African Institute of Mining and Metallurgy and a Fellow of the Australasian Institute of Mining and Metallurgy. He has served as editor-in-chief of *Mathematical Geosciences*.

Robert Earll McConnell Award to Larry A. Watters



WATTERS

The Robert Earll McConnell Award recognizes beneficial service to mankind by engineers through significant contributions that tend to advance a nation's standard of living or replenish its natural resources. The award is presented to Larry A. Watters "for his successes that advance clean coal technology and thereby extend the coal supply, globally improving standards of living and for training young engineers."

Watters is a founding owner of Taggart Global LLC, a company specializing in the design and construction of coal preparation plants and materials handling projects. He currently serves as an executive director responsible for operations in Australia, South Africa and international business development. Prior to formation of Taggart Global (then

known as Sedgman USA) in 1993, he worked as a principal process engineer for CLI Corp. and Kaiser Engineers.

Watters has more than 40 years of experience in the coal preparation industry, particularly in the areas of plant operations, process and materials handling design, construction and startup. He designed and directed construction of more than 100 coal preparation facilities in North America, China, South America, Russia, Indonesia, Africa and Australia. He has pioneered many of the new coal-cleaning technologies that improve efficiency and reduce costs. He holds six patents, all in coal preparation and beneficiation. These developments have improved coal yields and sulfur-ash rejection, thereby advancing clean coal technology and, ultimately, helping to extend the country's coal supply.

Watters received a B.S. in metallurgical engineering from the University of Washington in 1972.

Rossiter W. Raymond Award to Timothy W. Beck



BECK

Timothy W. Beck is the recipient of the Rossiter W. Raymond Award for his paper "Dust capture performance of a water exhaust conditioner for roof bolting machines." The award recognizes the best paper published by SME in a given period where the lead author is a member under 35 years of age.

Beck joined the National Institute for Occupational Safety and Health Office of Mine Safety and Health Research (OMSHR) in 2003. Currently, he is a research engineer and a part of the dust control team within the Dust, Ventilation and Toxic Substances Branch. His research focuses on field

and laboratory development and evaluation of dust control technologies for the underground coal mining environment, and he has published several papers evaluating engineering controls and innovative drilling techniques. Most recently, he completed an evaluation of a bit-sleeve device for controlling drill hole dust emissions. This research has been instrumental in stimulating industry adoption of newly identified technologies to reduce dust emissions and worker exposure.

Presently, Beck is updating the full-scale, longwall simulation laboratory at OMSHR, redesigning and replacing the mockup longwall shearer with a modern unit with advanced instrumentation. These changes will allow for finer control and more comprehensive monitoring of test parameters.

(Continued on page 69)

LARRY W. BERRY

An appreciation by Corolla Hoag, vice president, Mining Foundation of the Southwest

Larry Wayne Berry, 50, product manager of operation products at Mintec in Tucson, AZ, died on Dec. 20, 2012 after sudden illness.

Berry was born on March 20, 1962 in Florence, AZ and graduated from Howe High School in Howe, TX. During his studies at Colorado School of Mines (CSM), he worked as an operations instructor at the CSM experimental underground mine in Idaho Springs and was a surveying instructor. He received a B.S. degree in mining engineering from CSM in 1987.

Prior to moving to Tucson in 1990, Berry worked as a senior mine and maintenance engineer for Minera Martino SA de CV in Nayarit, Mexico, a construction coordinator for Amoco Production in Cook Inlet, AK and as a senior systems consultant for TCBC Computer Center in Anchorage, AK.

Once settled in Tucson, Berry joined Mintec, where he worked on mine evaluations, ore reserve estimation, mine plans, ore control and mine scheduling projects, primarily

for gold, copper and coal operations. He worked with many of the world's major openpit mines in the design and implementation of computerized grade control and drilling and blasting systems. He was the project coordinator for Mintec's first enterprise computing package, MineSight Operations. At the time of his death, he was the manager for Mintec's next generation of operational computing software, MineSight Axis.

His professional affiliations included SME, SME's Tucson Section and the Mining Foundation of the Southwest. Berry was noted for his generosity, willingness to help others and give back to his community through career presentations to his daughter's schools and talks about the mining industry to various organizations.

Berry is survived by his wife, Marta and daughters, Megan and Melissa. ■



BERRY

ERNEST THURLOW

An appreciation by his family

Ernest Emmanuel (Ernie) Thurlow died July 25, 2012 in Wickenburg AZ, two weeks short of his 95th birthday. He was born Aug. 8, 1917 in Vale, SD, seventh in a family of 10 children. He was raised in Rapid City, SD and attended the South Dakota School of Mines, earning a B.S. in geology in 1939. He then obtained a fellowship to attend the Montana School of Mines and earned his M.S. in geology in 1941. In 1942, he married Rose Marie Howard in Butte, MT.

Early in his career, Thurlow was employed by the Anaconda Copper, first in Butte and later, for three years, in Chuquicamata, Chile. In 1947, he joined the newly formed U.S. Atomic Energy Commission (AEC), Division of Raw Materials. After serving one year as a liaison with the US Geological Survey in Washington, DC, and another in working out of the New York City offices, he served as chief of the exploration offices in Spokane, Salt Lake City and Denver. His work took him to many sites in the United States, Canada, Mexico, Europe and Africa.

In 1958, sensing the coming transition of the commission from exploration to regulation, Thurlow chose to leave the AEC and took his family back to South America. For one year, he was chief geologist for Marcona Mining in San Juan de Marcona, Peru. Upon returning to the states in 1959, he accepted a position as chief geologist for the Northern

Pacific Railway and lived with his family in St. Paul, MN for the next 14 years.

Thurlow and his wife returned to Montana in 1973 and lived in Billings for the next 20 years. Until his retirement in 1981, he served as assistant vice president for Minerals and Land Development with the Burlington Northern Railroad. He continued to work occasionally as a private consultant into his 90s. He also spent the summer in Kalispell, MT, the winter in Wickenburg, AZ, and traveled frequently within the United States and to various countries around the world. Consistent with his life-long commitment to mining geology, he was able to convince two different tour groups, in Australia and Great Britain, to add stops at interesting mines rather than at the typical tourist attractions previously scheduled.

In 1993, the Thurlows moved to Wickenburg full time. He was preceded in death by his wife, Rose Marie, and his son, Howard Paul. He is survived by his sons, Greg and Richard; his daughter, Jane; eight grandchildren and one great-grandson. Anyone who knew Ernie will remember his ceaseless optimism, sense of humor and enduring faith. ■



THURLOW

Beck

(Continued from page 68)

A member of SME since 1997, Beck graduated from the Missouri University of Science & Technology with a B.S. in mining engineering. He is currently completing a master of public health degree in environmental and occupational

health from University of Pittsburgh with a certificate in health risk assessment. He received the John T. Boyd Memorial Young Engineer's Award from the Pittsburgh Section, the Woerner Award and the Stefanko Best Paper Award. ■



Up to \$500

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 Zurawski, Elzbieta S. ■



Process Plant Equipment: Operation, Reliability and Control

2012, edited by Michael D. Holloway, Chikezie Nwaoha and Oliver A. Onyewuanyi, published by John Wiley, sold by SME, 12999 E. Adam Aircraft Cir., Englewood, CO 80112, USA, www.smenet.org/store, e-mail books@smenet.org, phone 303-948-4225, 724 pp., hardcover book, \$150 SME member, \$130 student member, \$170 nonmember.

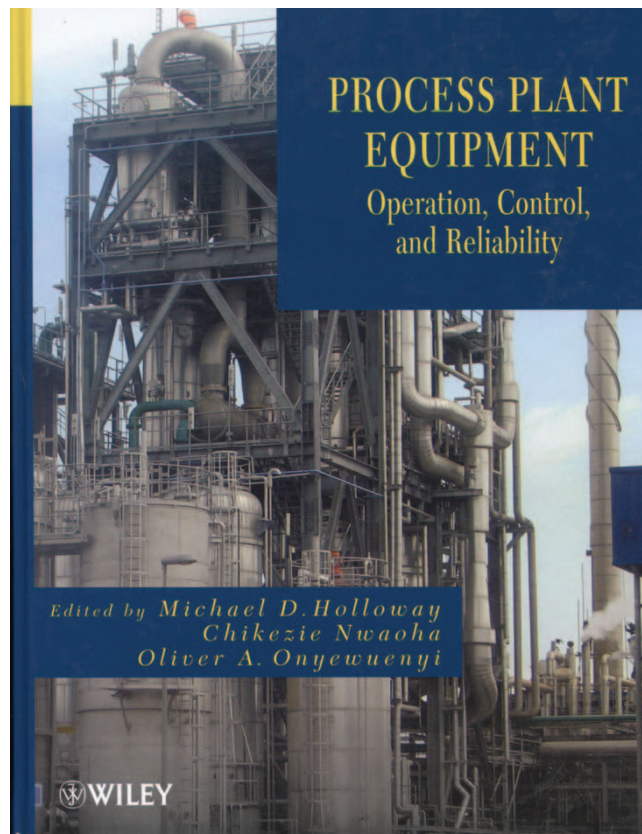
With *Process Plant Equipment: Operation, Control, and Reliability* as a guide, readers have the information and practical guidelines needed to select, operate, maintain, control and troubleshoot process plant equipment so that it is efficient, cost-effective and reliable throughout its lifetime. Careful explanatory text and instruction informs the reader how to reduce downtime and unscheduled shutdowns, streamline operations and maximize the service life of processing equipment.

The book is divided into three sections. "Section One: Process Equipment Operations" covers such key equipment as valves, pumps, cooling towers, conveyors and storage tanks.

"Section Two: Process Plant Reliability" sets forth a variety of tested and proven tools and methods to assess and ensure the reliability and mechanical integrity of process equipment, including failure analysis, fitness-for-service assessment, engineering economics for chemical processes and process component function and performance criteria.

"Section Three: Process Measurement, Control, and Modeling" examines flow meters, process control and process modeling and simulation.

Numerous photos and diagrams illustrate the operation and control of key process equipment. There are also case studies demonstrating how process plants have



implemented the tools and techniques discussed in the book. And there is an extensive list of references at the end of each chapter.

2012 reports from Roskill

Ground and Precipitated Calcium Carbonate

2012, published by Roskill Information Services, 54 Russell Rd., London SW19 1QL, England, phone +44-20-8417-0087, fax +44-20-8417-1308, e-mail info@roskill.co.uk, www.roskill.com/cc, 367 pp., US\$5,800, £3,500, €4,600.

Asia is now the fastest growing regional market for ground calcium carbonate (GCC) and precipitated calcium carbonate (PCC), mainly driven by the expansion in the Chinese paper and plastics sectors. The region consumed almost half of the GCC and PCC global demand in 2011. Demand for GCC and PCC grew because of increased mineral loadings in paper and to meet the rising demand for high-brightness paper. The plastics industry is the second largest market for calcium carbonate, and the Asian region leads the world in terms of consumption. Growth in terms of end-use markets will be led by the paper and plastics industries to 2016. The three leading producers, Omya, Imerys and MTI, together hold more than 40 percent of GCC capacity and 35 percent of PCC capacity.

Iron Ore: Market Outlook to 2020 7th edition

2012, published by Roskill Information Services, 54 Russell Rd., London SW19 1QL, England, phone +44-20-8417-0087, fax +44-20-8417-1308, www.roskill.com/iron-ore, 350 pp., US\$7,500, £4,500, €5,900.

While the price of iron ore appears set to make a partial recovery, Roskill's new report offers a deeper level of insight into the dynamics driving the market and offers a market outlook to 2020. Increased concentration, vertical integration and foreign ownership is likely. New capacity will exceed growth in demand and force high-cost operations out of the market. Downward revisions in the long-term outlook for iron ore demand and prices are likely to lead to the delay, suspension or cancellation of many projects. Even so, Roskill estimates that 425 Mt/a (469 stpy) of nameplate capacity will be added from the middle of 2012 to the end of 2014 and that capacity additions will continue to exceed 100 Mt/a (110 stpy) through to 2020. These additions are likely to exceed demand growth, mostly low- to medium-cost operations. ■

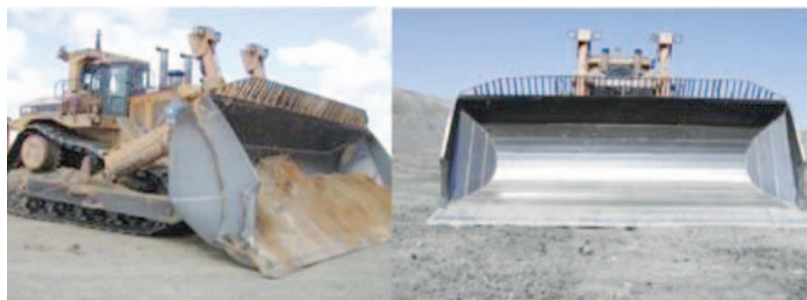


New Products

Arcoplate from Alloy Steel improves profits

Arcoplate is used in the toughest abrasive environments to protect crusher and bin liners, chutes and other fixed plant. It reduces wear costs, labor costs and, most important, reduces downtime.

The Arcoplate process enables a homogeneous alloy overlay to be smoothly bonded to a mild steel backing with a 100-percent metallurgical bond between the alloy and the mild steel. Within specified limits, this bond will withstand any rolling or pressing that may be required in the formation of various wear liner shapes. It also withstands the impacts experienced in the operation of plant and equipment without fracturing and spalling of the alloy overlay.



Before and after — Arcoplate's slick, smooth surface eliminates costly hang-ups and carryback, which saves fuel and increases productivity.

Arcoplate is manufactured by a weld cast method, which removes the problems and alloy limitations imposed by the old-fashioned welding methods. It is able to ensure full bonding of the alloy with no ridging or incomplete joints and to achieve a homogeneous layer regardless of the thickness of the overlay.

www.alloysteel.net

Talpac software is updated with the latest equipment launched at MINExpo

RungePincockMinarco has released an update for Talpac, an independent haulage and loading simulator. Talpac is used by mining operations to evaluate the performance of mixed fleets, as an essential tool in the equipment selection and justification process. The new release adds the equipment introduced at MINExpo 2012 to its database of trucks, loaders, scrapers and underground equipment.

The update includes Caterpillar's MT4400D ac Unit Rig truck and 777G off-highway truck, Komatsu's 750E (ac) truck and Hitachi's EH 5000AC-3 truck, in addition to new or upgraded equipment from Liebherr, Bell, Volvo, Belaz and P&H.

Using logic that models real haulage situations, Talpac allows the study of measurable factors that affect productivity and how a fleet will react to them. A company can investigate and compare time period productivity; travel, loading and wait times; fuel usage; wear and tear, and average operational costs. All of this can be done on an incremental basis, exploring different network scenarios by making changes to ramp grades, route surfaces and other variables. The data base includes more than 500 trucks and 400 loaders and is updated annually.

www.rpmglobal.com

Florida power plant saves coal supply costs with FuelSolv from GE

The city of Lakeland, FL and its McIntosh power plant unit #3 will save between 15 and 20 percent of coal supply costs per year using GE's FuelSolv coal treatment technology. FuelSolv is a fuel treatment program for deposit control that increases efficiency and reduces costs.

A typical coal-burning power plant will spend approximately 70 percent of its operating budget on fuel. Plant boilers can have ash slag deposits on the boiler walls, superheater and reheater tubes, which reduces efficiency and increases operating costs due to tube failures, decreased heat transfer and increased maintenance costs. FuelSolv reduces slagging, which, in turn, allows the plant to operate at maxi-

mum loads with minimal need to shut down for cleaning. Deposits that do form in the combustion zone are generally easier to remove, which reduces the down time required to carry out mechanical cleaning.

The plant is also using GE's Zonal combustion monitoring system to help improve boiler reliability and efficiency while reducing emissions. The combustion monitoring system provides real-time mapping of combustion quality to identify poor combustion zones and helps operators and engineers run the boiler at balanced combustion conditions.

www.ge-energy.com

Sandvik offers certified rig for high-risk environments

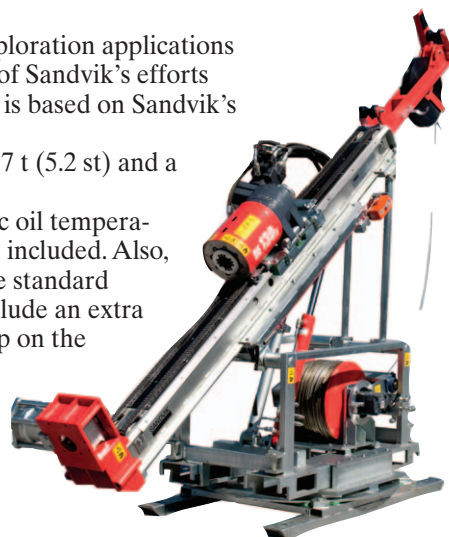
Sandvik's DE100 series of compact core drills for surface and underground exploration applications now includes a fully ATEX certified rig, the DE130x. Its development is part of Sandvik's efforts to integrate environment, health and safety features into its products. The design is based on Sandvik's DE130 core drill.

The DE130x has a depth capacity of 815 m (2,674 ft) N-size, a feed force of 4.7 t (5.2 st) and a pull force of 6.3 t (6.9 st).

The drill features a completely redesigned power unit that monitors hydraulic oil temperature, electric motor temperature and incoming power. Intrinsic safety circuits are included. Also, in accordance with ATEX standards in Europe, some of the parts featured on the standard DE130 have been replaced by steel parts. Additional features on the DE130x include an extra gauge for rod-holder surveillance on the control panel and a wire emergency stop on the feed boom for increased safety.

www.mc-sandvik.com

The DE130x is a certified exploration drill rig for underground coal applications.



OperTrak tire- and rim-tracking system is available from Michelin

Michelin Earthmover has released OperTrak, a comprehensive, easy-to-use, web-based tire- and rim-management system designed to monitor tire activity and optimize budgeting, forecasting, inventory and performance.

OperTrak offers a comprehensive fleet inspection tool, multiple-user input and retrieval capability, and complete fleet-data consolidation. OperTrak reports, which can be exported in several formats, consolidate information from

multiple company sites and can be configured through various organizational levels. The information can be viewed by region, zone, state, site or other criteria to meet user needs. Data within other tire tracking systems can be transferred at no additional cost. The software and data are ISO227001 certified.

www.michelin-us.com

IROCK Crushers introduces TS-522 heavy duty screener

IROCK Crushers' TS-522 heavy duty screener is suitable for medium- to large-scale operations. It is ideal in mining, sand and gravel or recycling applications as a part of a crusher circuit. Built for high productivity, the TS-522 features extra hopper capacity, a large screening area and the highest stockpiling capability of any screener this size. The TS-522 is powered by a 129-hp Caterpillar C4.4 engine and is capable of processing materials at a rate of up to 610 t/h (670 stph).

The 4.3 m-(14-ft-) wide hopper feeder that is standard on the TS-522 is rated to 9.2 m³ (12 cu yd). This extra space is built to accommodate a greater amount of material, enabling higher production rates.

The TS-522 also offers ample screening area, which further contributes to the machine's high output ratings. The machine has a total screening area of 19.5 m² (210 sq ft). The two-deck design enables users to produce and sort up to three different size products. IROCK also offers the TS-522 TD, a three-deck version of the screener. The decks can be interchanged so customers have more control over end-product size. Hydraulically folding side conveyors provide the stacking heights necessary to match the machine's high output rates. Able to stack up to 5.1 m (16.7 ft) on the sides and 5 m (16.2) on the tail, these conveyors provide the convenience of running the machine for longer periods before needing to reposition finished material. ■

www.irockcrushers.com



Hydraulically folding side conveyors provide the stacking heights necessary to match the machine's high output rates.



Coming Events/Short Courses

Upcoming SME Events

**SME Annual Meeting and CMA
National Western Mining Conference**
Feb. 24-27, 2013
Colorado Convention Center
Denver, CO, USA

**Current Trends in Mining
Finance**
Apr. 29-30, 2013
City University of New York
New York, NY, USA

**Rapid Excavation and
Tunneling Conference**
June 23-26, 2013
Marriott Wardman Park
Washington, DC, USA

For additional information, contact: Meetings Dept., SME
Phone 800-763-3132 • 303-948-4200 • Fax 303-979-3461 • email sme@smenet.org • www.smenet.org

Visit www.miningengineeringmagazine.com for more industry events or to list your event online.

February 2013

12-14 • Microtunneling Short Course
Colorado School of Mines, Golden, CO, USA
Phone: 303-273-3321 • Fax: 303-273-3314
email: space@mines.edu
<http://csmspace.com/events/microtunnel>

21-22 • Coal Mongolia 2013
SS Convention Center, Ulaanbaatar, Mongolia
Phone: 976-7011-5590
email: registration@coalmongolia.mn
www.coalmongolia.com

22-23 • Mining India Conference
The Taj Vivanta, Bangalore, India
Phone: 91-74064-64314
email: devksingh2005@gmail.com
www.im-mining.com/2012/10/11/mining-india-conference-the-future-of-mining

March 2013

3-6 • PDAC 2013 International Convention
Metro Toronto Convention Center, Toronto, ON, Canada
Phone: 416-362-1969 ext. 1 • Fax: 416-362-0101
email: convention@pdac.ca
www.pdac.ca

3-7 • TMS 2013 Annual Meeting and Exhibit
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Phone: 724-776-9000 • Fax: 724-776-3770
email: tmsgeneral@tms.org
www.tms.org

**17-20 • 2013 National Stone, Sand and Gravel Association
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www.nssga.org

April 2013

3-5 • Argus Coal Summit 2013
Intercontinental Miami Hotel, Miami, FL, USA
Phone: 713-429-6110
email: antonette.jones@argusmedia.com
www.argusmedia.com/Events/Argus-Events/America/Americas-Coal-Summit/Home

14-18 • Environmental Considerations in Energy Production

Charleston Marriott Town Center, Charleston, WV, USA
Phone: 303-948-4200 • Fax: 303-979-3461
email: meetings@smenet.org
www.smenet.org/page/index.cfm?id=1005

15-17 • Mine Water Solutions in Extreme Environments

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15-21 • bauma 2013

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email: info@bauma.de
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16-19 • World CTL 2013 Conference

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16-17 • Joint Technical Conference: SME Minnesota Section, Univ. of Minnesota Mining Symposium and CIM - Montreal Branch Iron Ore Symposium

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www.d.umn.edu/goto/sme

30-May 2 • Coal Prep 2013

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email: registration@penton.com
www.coalprepshow.com/CoalPrep2013

May 2013

5-8 • CIM 2013 Convention

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<http://web.cim.org/toronto2013beta> ■



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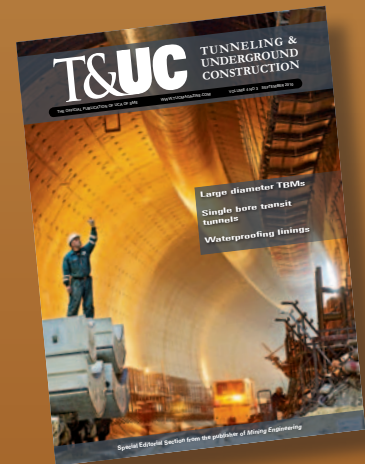
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Job duties and responsibilities include administration and facility management, budget and project reviews, strategic and implementation plans, directing professional and technical unit personnel, coordinating research projects and external sales activities with industrial and commercial clients, and management of analytical services laboratory. The successful candidate will also provide support to Minnesota iron ore operations, advance industrial minerals by-products programs, develop new mineral recovery and hydrometallurgical processing technologies for non-ferrous operations, advance technologies for environmental issues, develop new research to assist iron ore, non-ferrous and environmental remediation industries, assist in grant writing and issue technical reports and papers.

Minimum Qualifications: Master's degree in Mineral Engineering, Mineral Processing, Chemistry, Chemical Engineering, Geological Engineering, Management of Technology, Engineering Management, Metallurgical Engineering or related field from a regionally accredited institution with two years minimum experience in planning, executing, and reporting mineral research and development programs related to iron ore, non-ferrous or industrial minerals recovery activities. Extensive experience with Microsoft Office software products and excellent written communication skills in the English language.

Desired Qualifications: Ph.D. from a regionally accredited institution in one of the academic fields noted above and minerals processing or extractive metallurgical experience in iron ore mining operations or non-ferrous operations; research experience in minerals beneficiation including grinding, classification, magnetic separation, flotation and/or agglomeration; and experience in hydrometallurgical processing. The ideal candidate would also possess a successful track record in obtaining grants and in executing research and development projects. The individual should also be able to collaborate with other researchers across a broad organization or with industrial partners. Demonstrated ability to work both independently and in a team environment with strong organizational and time management skills. Strong oral proficiency in English and demonstrated evidence of the ability to work effectively with diverse groups.

Review of complete applications will begin immediately and will continue until the position is filled. For a complete position description and information on how to apply online, go to <http://employment.umn.edu> and search for Job Req 181096. Complete applications must include the online application, letter of application, CV/resume, graduate transcript and name, address, and telephone number of three references. Finalist will be required to submit an affirmative action accomplishment statement. Official transcript will be required to be submitted by finalists. Individuals from underrepresented groups and US military veterans are encouraged to apply. Smoking is prohibited on all UMD property. The smoking ban includes indoor facilities and the campus grounds, as well as all University vehicles. If you need a reasonable accommodation for any part of the application and hiring process, please contact the University of Minnesota Disability Specialist at 218-726-7725.

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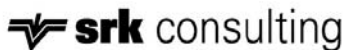
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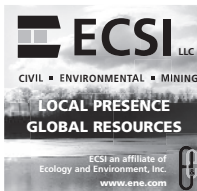
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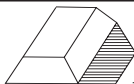
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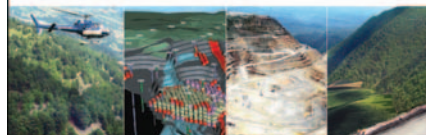
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Sunday, February 24, 2013

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April 14-18, 2013 · Marriott Charleston · Charleston, West Virginia

This conference is aimed at bringing together interested parties from around the world to exchange ideas on energy production, including mining, oil and gas production and electrical power generation, and the impacts on the environment and society. The goals of this meeting are: to discuss 1) existing and emerging problems, 2) appropriate and innovative solutions and, 3) best practices and techniques; and to develop collaborations and open dialog on the impacts of energy production on the environment. Many of the issues relate to how environmental impacts and energy production in general affect community well-being and human health

The conference will feature plenary and keynote sessions with key political and industry leaders which provide context for the technical issues being discussed. The main focus is the technical sessions where researchers will discuss their work and scientific dialogue will be encouraged.

Tentative technical sessions will focus on:

- Total dissolved solids and environmental impacts
- Coal, gas and energy production
- Environmental considerations in coal preparation and waste management
- Community well-being
- Landforming and geomorphic reclamation
- Public health and energy production
- Watersheds
- Environmental considerations in underground mining
- Stream biota impacts
- Environmental considerations in surface mining
- Selenium in the environment
- Stream restoration
- Energy resources and sustainable development

IMPORTANT INFORMATION

Registration information and full conference programs will be available by December 2012.

ARIES and the Organizing Committee will provide peer- review of all papers, which will be incorporated in a proceedings volume published by SME.

TENTATIVE SCHEDULE

Sunday, April 14

Short courses
Registration
Hosted Reception

Monday, April 15

Plenary Keynote session
Technical session
Hosted lunch in exhibit hall
Technical sessions 2
Reception
Conference Banquet with speaker

Tuesday, April 16

Technical sessions
Hosted luncheon with speaker
Technical sessions

Wednesday, April 17

Technical sessions
Plenary closeout session

Thursday, April 18

Optional field trip

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Steve Kral,
Editor

SME meeting to attract 5,500+

The theme of the SME Annual Meeting this year is “Mining: It’s About the People.” This is an appropriate theme because it is no secret the global mining industry is facing a severe labor shortage in the not-too-distant future.

The meeting, scheduled for Feb. 24-27 at the Colorado Convention Center in Denver, is expected to attract more than 5,500 professionals from around the world. The SME Annual Meeting will be held in conjunction with the Colorado Mining Association’s 115th National Western Mining Conference.

The National Academies’ National Research Council, through a contract with the U.S. Department of Energy’s National Energy Technology Laboratory, asked SME to collect, analyze and report on workforce trends in the mining industry. The results of the SME study were not rosy. The report concluded that it is unlikely that there will be sufficient skilled mine labor to satisfy the demand during the next 20 years.

A global increase in demand for mined minerals, along with a steady stream of retirements, will mean more attractive, high paying jobs in the mining industry. However, there may not be enough young professionals available to fill them. The SME study also said that the domestic mining industry will, for quite some time, be composed of very young people and senior workers. One important implication of that will be worker health and safety concerns.

Four experts on education and labor issues will address the coming labor shortage in the Keynote Session on Monday morning. The session, moderated by M.W. Bill Scoggins, president of the Colorado School of Mines, will feature Cy Butner, senior program officer, National Academy of Sciences; Leigh Freeman, general manager, Downing Teal; Elaine Cullen, vice president, Safety Solutions International; Gerry Wheeler, executive director, National Science Teachers Association; Gwenne Henricks, vice president, Caterpillar Inc.; Andrew Slenz, senior vice president human resources, Peabody Energy; and Bill MacGowan, executive vice

president human resources and communication, Newmont Mining Corporations.

In addition to the Keynote Session, the meeting will feature about 500 technical presentations in 95 sessions. It is in these sessions where attendees will find the latest in technological advances in mining, exploration, geology, minerals processing, metallurgy, coal, industrial minerals, underground construction and tunneling, bulk materials handling and other segments of the industry.

Seven short courses are planned for the meeting. Held on the Saturday and Sunday before the meeting begins, the courses include “Copper Heap Leach,” “Introduction to the Design of Bulk Material Handling Conveyors,” “Ore Reserve Risk and Optimization in Strategic Mining Planning: Stochastic Models and Optimization,” “Basic Safety and Health Practices for the Mining Industry,” “Seismic Analysis and Interpretation for Mining,” “Ground Freezing for Mining Applications,” “Mine Water Balance 101” and “Overview of Sustainability Reporting and GRI for Extractive Professionals.” In addition, a pair of field trips are planned to the Cripple Creek & Victor gold mine and the Henderson molybdenum mine, depending on registration.

Student activities include the Student Design Competition, sponsored by Hitachi Construction and Mining; the Student Chapter Representative Subcommittee meeting; the 2013 Student Forum, sponsored by MWH Global; and the Student Mixer, sponsored again by Newmont Mining Corp. Newmont Mining is also the official SME Annual Meeting sponsor. And, of course, the highly successful Student Mentor program, which pairs students with mining professionals, will take place.

The SME Foundation will host its annual banquet Sunday night. The Mardi Gras and Casino Night theme will also feature a silent auction to benefit the foundation. And the foundation will have its annual silent auction in the exhibit hall.

The exhibit at the SME Annual Meeting gets larger every year. And 2013 is no exception. More than 700 companies will be exhibiting in Denver. That is a lot of advanced technology, equipment and services in one exhibit hall. The ShowGuide, bound into this issue, provides a listing of each exhibitor, their products and services and their location. ■

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The Society for Mining, Metallurgy, and Exploration, SME (www.smenet.org) will host its first annual conference on Current Trends in Mining Finance in New York City. This two-day conference is intended for senior executives as well as mining industry specialists among bankers, analysts and investors, and will cover a range of important topics, including: general trends in project evaluation and investment decision-making; drivers of future industry mergers and acquisitions; tax and accounting issues facing the mining industry; risk factors in the current market environment; new sources of funding for mining projects; trends in mineral development agreements; and the impact of “soft” issues on mine development and finance. This is a unique opportunity to get current on important issues that affect project finance, investment and strategic planning. Send your abstract now for consideration. Space is limited.

Monday, April 29, 2013

Conference Chairman's Opening Remarks

A Look Back – What Just Happened?
A Review Look at the Past Ten Years Since 2002

Outlook for the Base Metal, Bulk and Industrial Minerals Sectors

Bankers' Perspectives About Trends in Mining Finance and Capital Markets

Regulatory and Compliance Issues Impact on Mining Finance and Investment

Strategic and Financial Planning Challenges for Operating and Exploration Companies

Importance of Quasi Government State-Owned Enterprise Investment in Mining

Legal, Tax, Accounting Issues Impacting Sources of Mining Finance

The Evolving, Changing Global Economic Political Landscape and Mining

Tuesday, April 30, 2013

Future Precious Metals Prices: How Best to Invest: Physicals? Equities? ETFs? Projects?

Base, Precious and Industrial Minerals Properties and Projects Valuations

What are the Trends, Benchmarks Driving Equity and M&A Valuations?

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