



## The International Network for Acid Prevention

*An organization of international mining companies dedicated to a reduction in the liability associated with sulphidic mine materials*

January 2003

**NEWSLETTER**

[www.inap.com.au](http://www.inap.com.au)

In this Newsletter:

1. **HEAP LEACH WORKSHOP IN ELKO**
2. **OPCOM MEMBERS**
3. **RECENT MEETINGS**
4. **REGIONAL ORGANISATIONS**
  - **ADTI NEWS**
  - **ACMER NEWS**
5. **6<sup>TH</sup> ICARD**
6. **WEB SITE CHANGES**
7. **STUDY ON INTER-ORGANIZATIONAL NETWORKS**
8. **UPCOMING MEETINGS**
9. **INAP RESEARCH PROJECTS**
10. **NEXT NEWSLETTER**

*This newsletter is published by the INAP Operating Committee (OpCom) and is available via the INAP web site <http://www.inap.com.au>, INAP's primary communication medium. For further information in the first instance please contact the INAP Technical Manager, Anne-Marie Fleury.*

#### **CONTACT DETAILS**

**INAP Technical Manager - Anne-Marie Fleury**  
[amfleury@hotmail.com](mailto:amfleury@hotmail.com), +56 2 330 5177, Santiago Chile  
**INAP Administrator - Franca Tomaras**  
[Franca.Tomaras@riotinto.com](mailto:Franca.Tomaras@riotinto.com), +61 3 9592 4414, Melbourne Australia  
**INAP OpCom Chairman - Ross Gallinger**  
[Ross.D.Gallinger@bhpbilliton.com](mailto:Ross.D.Gallinger@bhpbilliton.com), + 56 2 330 5983, Santiago Chile

---

### **1. Heap Leach Workshop in Elko**

INAP would like to draw attention to the upcoming **Heap Leach Closure Workshop** to be held in Elko, Nevada March 25-26, 2003. The Mining Life-Cycle Center (MLC) from the Mackay School of Mines, University of Nevada in Reno will be hosting the meeting. Sessions will focus on estimating

leachate quantity and quality, cover design, and leachate management and mitigation. The workshop registration fee is 100USD. We invite you to contact Dr. Dirk van Zyl ([dvanzyl@mines.unr.edu](mailto:dvanzyl@mines.unr.edu)) or visit the web site (<http://www.unr.edu/mines/mlc/index.html>) for further information.

INAP encourages everyone to participate as the event will also provide a venue for **INAP's Board and OpCom Annual General Meeting** as well as the Acid Drainage Technology Initiative Metal Mining Sector Technical Committee meeting.

## 2. OpCom Members

INAP is pleased to announce two new members to the OpCom. Dr. Jos Schaekers, Head of Process & Environmental Chemistry for BHPBilliton at the Johannesburg Technology Centre will be joining as of January 2003. Larry Todd, from the research facilities of Phelps Dodge in Arizona, USA will also be joining the OpCom, replacing Rick Mohr from Phelps Dodge. OpCom members are as follows:

Chairman: Ross Gallinger – BHPBilliton  
Bruce Kelley – Rio Tinto  
Denis Kemp – Falconbridge  
Jos Schaekers - BHPBilliton  
Larry Todd – Phelps Dodge  
Les Hulet – INCO  
Mandy Agnew – Rio Tinto Contractor  
Mark Tieszen – Barrick  
Mike Aziz – Placer Dome  
Nick Currey – Placer Dome  
Peter Waters – BHPBilliton  
Robert Prairie – Noranda  
Steve Slater – Rio Tinto

## 3. Recent Meetings

Recent INAP OpCom meetings were held in November 2002 in Newcastle, Australia and in December 2002 in Vancouver, Canada. Several matters of strategic importance were discussed and are summarised below.

### Research Proposals

The OpCom has reviewed its method for solicitation and selection of research proposals. INAP will aim to receive the bulk of annual proposals early each calendar year through a single point of contact, the Technical Manager. In an effort to be transparent, project solicitation criteria will be made public via the web site.

INAP will focus on its strengths, using resources for seed funding of projects and for information sharing on the latest acid drainage (AD) research. To optimise available funds, leverage opportunities will be favoured.

#### Database of Industry Experience

An important 2003 INAP project is to build a database of industry experience. The aim is to bring together the wealth of publicly available company AD information. The database will include documents such as conference presentations from member companies, data from closed sites, or Environmental Impact Assessments (EIA).

#### INAP Brochure

A informational INAP publication is being designed for distribution at important mining conferences and workshops. This brochure-style document should be available at the 6th International Conference on Acid Rock Drainage (6<sup>th</sup> ICARD - July 2003).

### 4. Regional Organisations

A series of discussions with the regional organisation partners have resulted in an agreement to work together under a common Statement of Mutual Intent (SMI). Each group is reviewing the draft for finalisation. The partnership will foster collaboration on workshops and research projects, particularly leverage opportunities. Each group agreed to delegate a single contact person.

- ◆ Gilles Tremblay for the Mine Environmental Neutral Drainage Programme in Canada (**MEND/NEDEM** - <http://mend2000.nrcan.gc.ca/>)
- ◆ Charles Bucknam for the Acid Drainage Technology Initiative (**ADTI**) - Metal Mining Sector (MMS) and Coal Mining Sector (CMS) in the USA (<http://www.unr.edu/mines/adi/> and <http://www.nrcce.wvu.edu/nmlrc/nmlrchometext.htm>)
- ◆ Clive Bell for the Australian Centre for Mining Environmental Research (**ACMER** - <http://www.acmer.com.au/>)
- ◆ Anne-Marie Fleury for INAP

INAP and associated regional organisations are actively seeking potential partners in Europe, South Africa, and South America. Suitable groups should have AD research expertise in their regions, and be able to engage research providers, academics, and governments. The regional organisation partnership is at no cost and funding for specific collaborative projects is decided on a case-by-case basis.

### ***ADTI News***

The Molybdenum Corporation of America (Molycorp) is investigating the long-term weathering effects on its waste rock piles at Questa, New Mexico, USA over engineering time ( $\pm 100$  years) and geologic time (well beyond 100 years). Molycorp has invited 4 university research groups to submit proposals to develop a model that assesses the risk of slope failure of the piles based on their physical, chemical and mineralogical properties, and the weathering of the rock over time.

Molycorp requested ADTI-MMS to supply at least three members for a technical review team to monitor and evaluate research progress over the 3-5 year project period.

A kick-off meeting was held January 16-18 in Taos, NM where finalist research teams were selected by Molycorp and the ADTI-MMS review team. The final selection of the research team will be made in March 2003, at which time the work will begin.

### ***ACMER News***

In the latter part of 2002, ACMER conducted two successful one-day courses prior to the Minerals Council of Australia Sustainable Development Conference in Newcastle, Australia, viz.

- ◆ Acid Mine Drainage Generation, Management and Treatment, Nov 9<sup>th</sup>  
Thirty-two delegates from the mining industry within Australia, Indonesia, South Africa, and South America attended in addition to government representatives and consultants. Speakers included Dr. Paul Brown (Sulphide Solutions, Australian Nuclear Science and Technology Organisation (ANSTO)), Dr. Stephen Dobos (Dobos and Associates) and Dr. Jeff Taylor (Earth Systems).
  
- ◆ Design of Covers for Saline, Sodic and Sulphidic Wastes, Nov 10<sup>th</sup>  
Thirty-four participants attended this course. Speakers included Professor Ward Wilson from the University of British Columbia, Dr. Andrew Garvie (Sulphide Solutions, ANSTO), Dr. Rob Loch (Landloch), Associate Professor David Williams (University of Queensland) and Professor Clive Bell, Executive Director of ACMER.

## **5. 6th ICARD**

ACMER and the Australasian Institute of Mining and Metallurgy (AusIMM) are organising the 6th ICARD to be held in Cairns, Australia from 12-18 July 2003.

ICARDs are the pre-eminent conferences for discussion of cutting-edge research and innovative technologies relevant to acid drainage. The 6th

ICARD will continue this tradition with its theme of "Application and Sustainability of Technologies", which will enable a timely review of the range of approaches developed for the prediction, prevention, treatment and monitoring of acid drainage.

An exciting programme, involving pre-conference short courses and field trips to mines, and 3½ days of technical sessions featuring 120 oral presentations and 70 posters, has been developed to cater for the interests of mining personnel, regulators, consultants and researchers from all the major mining areas of the world.

The INAP Board has approved sponsorship of the 6<sup>th</sup> ICARD. The event will feature an INAP booth and official publications will carry the INAP logo. The opening plenary session will include a presentation on the INAP Regional Network by Dr. Robin Batterham, Chairman of the Board of INAP, and Ross Gallinger, Chairman of the INAP OpCom. This will be followed by presentations on acid drainage programmes worldwide, including INAP partner regional organisations (ACMER, ADTI, and MEND/NEDEM).

In addition, INAP is continuing to explore the possibility of becoming the "home" of the ICARD conferences, particularly by maintaining a record of previous ICARD papers on the INAP web site.

The registration brochure for the Conference, which can be accessed at [www.ausimm.com](http://www.ausimm.com), will be distributed at the end of January 2003. Please contact Clive Bell ([c.bell@uq.edu.au](mailto:c.bell@uq.edu.au)) for more information.

## **6. Web site Changes**

Changes to the INAP web site have been approved by the OpCom and are underway. Modifications will aim to make the site more user-friendly by reducing the number of homepages, simplifying the links, and including more publicly available information.

The OpCom invites its members and the public to provide photos from mine sites to post on the web site. Please contact Anne-Marie Fleury ([amfleury@hotmail.com](mailto:amfleury@hotmail.com)).

## **7. Study on Inter-Organizational Networks**

Monash University in Melbourne, Australia is undertaking a review of the INAP network within their study of international, inter-organisational networks. The final results are expected next month and will outline observations on some of the strengths and weaknesses of INAP.

## 8. Upcoming Meetings

INAP and Regional Organisation Meetings scheduled to date are as follows:

- ◆ **Elko**, Nevada, USA  
March 24, 2003 INAP Board Meeting  
**March 25-26, 2003 Heap Leach Workshop**  
March 26-27, 2003 INAP OpCom Meeting  
March 26, 2003 ADTI MMS meeting
- ◆ **Cairns**, Australia  
**July 12-18, 2003 6<sup>th</sup> ICARD**  
July - INAP OpCom and Regional Organisations Meetings
- ◆ **Vancouver**, Canada  
**December 2003 BC ARD Conference**  
December 2003 INAP OpCom and Regional Organisations Meetings

ADTI Meetings scheduled to date are as follows:

- ◆ **Cincinnati**, Ohio, USA  
**February 24-26, 2003, SME Annual Meeting**  
February 26, 2003 The Acid Drainage Technologies for Metal and Coal Mining technical session  
February 27, 2003
  - ADTI Operations Committee Meeting
  - ADTI MMS and CMS Steering Committee Meeting
  - ADTI MMS Administrative Committee and Non-profit Organization Board of Directors Meetings
  - Field trip to the National Risk Management Research Laboratory at the EPA's Office of Research and Development
- ◆ **Denver**, Colorado, USA  
**February 2004 SME Annual Meeting**  
ADTI-MMS members will be co-chairing several sessions including the five Sustainable Development sessions as well as a number of SME Environmental Division sessions

Other Meetings:

- ◆ **Syncrude** Instrumented Watershed Technology Transfer Meeting  
Date to be confirmed, Edmonton, Canada
- ◆ Mining and the Environment 3 Meeting hosted by Laurentian University  
May 25-28, 2003, **Sudbury**, Canada  
[www.sudbury2003.ca](http://www.sudbury2003.ca)

- ◆ The annual convention of the Prospectors and Developers Association of Canada (**PDAC**)  
March 9-12, 2003, Metro Toronto Convention Centre, Canada  
<http://www.pdac.ca/pdac/conv/>
- ◆ Post-Mining 2003, Impacts and Risk Management hosted by the Institut National Polytechnique de Lorraine, organized by **GISOS** Research Group for the Impact and Safety of Underground Works  
February 5-7, 2003, Nancy, France  
<http://www.mines.u-nancy.fr/gisos/postmining2003/index.html>
- ◆ Perspectives on the Economics of Sustainable Mining organized by the Mineral Economics and Management Society (**MEMS**)  
April 9-11, 2003, Golden, Colorado  
[http://www.mines.edu/outreach/cont\\_ed/mems.html](http://www.mines.edu/outreach/cont_ed/mems.html)
- ◆ The Canadian Institute of Mining, Metallurgy and Petroleum organizing the **CIM** Mining Industry Conference & Exhibition  
May 4-7, 2003, Montreal, Canada  
<http://www.tradex.cim.org/index.cfm>
- ◆ The 1st International Symposium on Processing & Disposal of Mineral Industry Wastes (**PDMIW '03**), organized by Minerals Engineering International (MEI) in collaboration with Technical University of Delft, The Netherlands, and the Camborne School of Mines, UK.  
June 18-20, 2003, Falmouth, UK  
<http://www.min-eng.com/pdmiw03/index.html>
- ◆ **Tailings and Mine Waste '03**, Colorado State University  
October 12-15, 2003, Vail, Colorado  
<http://www.tailings.org/>

## 9. INAP Research Projects

The following is a summary of recent INAP research projects. More information, including project reports and presentations, is available on the web site [www.inap.com.au](http://www.inap.com.au).

### ***Tailings and Waste Rock Co-Mix***

The project was designed to examine the stability and hydraulic conductivity of covers made of different co-mixtures of mine waste. Varying ratios of tailings, waste rock and slag were examined. Past research has been conducted on other materials with low hydraulic conductivity, however they proved to be sometimes unstable in harsh climates subject to freezing and desiccation. This project was of immediate interest to Inco, and there was an

indication that it was also relevant to mining companies operating in a variety of harsh conditions.

Dr. Ward Wilson from the University of British Columbia completed the work with a graduate student. Inco also funded Mr. Dave Landriault from Golder Associates to provide a cost analysis for the preparation of co-mix covers based on the findings of Dr. Wilson.

The findings of the work can be summarized briefly as follows:

- The co-mixtures of slag, waste rock and tailings provided a material that showed both excellent geotechnical characteristics and varying degrees of hydraulic conductivity.
- When bentonite was added to the co-mix the conductivity decreased to approximately  $10^{-9}$ . This indicates that once the desired characteristics of a cover are determined, it is possible to blend mixes with varying properties to meet these needs.
- Estimates of cost indicate that the covers would potentially be expensive. Bentonite addition increased the overall cost per area of co-mix covers considerably. Future focus should include an examination of providing these mixes in a cost effective manner.

Inco, Dr. Wilson, and others are examining possible follow-on projects based on the findings of this study. The establishment of a test plot will allow the characteristics of co-mix covers to be measured under field conditions.

### ***Scale-Up Review Phase***

Information from large-scale waste rock test piles could significantly improve prediction techniques for the behaviour of sulphide containing waste rock dumps. However, large-scale test pile work usually involves high costs making it difficult to fund these tests. The Scale-up project was designed to undertake waste rock studies on selected mine material at laboratory and test pile scales in a phase 1, and at field scale in a phase 2. In June 2000, a preliminary review phase was initiated to identify suitable mine sites for the scale-up research.

The review phase was completed in April 2002 by John Bennett from ANSTO and David Blowes from the University of Waterloo. Six sites were identified for participation in Phases 1 and 2 of the Scale-Up Project: KPC, Antamina, Lihir, Porgera, Diavik and Greens Creek.

### ***Scale-Up Business Plan Development***

A Business Plan for the full Scale-Up Project was drafted by the contractors (J. Bennett & D. Blowes) in September 2001 and is being finalised. The plan outlines phases 1 and 2 of the project and the expected outcomes. These will consist of prediction tools to determine the following:

- If low quality drainage (LQD) will be released from waste rock.



- How soon after the construction of a waste rock facility LQD appears.
- The amount of LQD produced.
- How long LQD persists.

### ***Hydrologic and Geochemical Characterization of Waste Rock Dumps***

In 2000, waste rock dumps from the Rio Tinto Kennecott Ridgeway Mine and the Inco Whistle Mine needed to be relocated. The opportunity was seized to initiate a study to advance the understanding of the geochemical and hydrological nature of waste rock dumps and the extent of oxidation zones within them. The project was initiated in June 2000 by Dr. Ward Wilson working with Pam Fines and Ai Binh Tran from the UBC Dept of Mining & Mineral Engineering, Maree and Stuart Miller from EGi, and David Williams from the University of Queensland.

Field sampling and laboratory analysis has been completed and preliminary observations linking the hydrological and geochemical nature of the dumps have been made. The dumps contain complex hydrological pathways that dictate the geochemistry of the drainage released from the dumps. There is an indication that many of the layers within the dumps contain large amounts of stored oxidation products and soluble metals, which may not have an adequate degree of saturation to allow flow of water through the layers, thus reducing final drainage concentrations. The project was completed at the end of December 2002, and a report is expected in the next month.

The project was funded by INAP, NSERC, and R&D Start Funds.

### ***Passivation of Acid Generating Materials***

The passivation project is evaluating a new technology to 'passivate' or neutralize acid generating materials on the pit walls at the Golden Sunlight Mine of Placer Dome. The passivation technology is based on the use of potassium permanganate and magnesium oxide at a pH>12. The University of Nevada, is conducting the study, led by Dr. Dirk van Zyl for phase 1 and Dr. Tim Tsukamoto for phase 2.

The first phase of the project was initiated in August 2000 and completed in September 2002. A second phase of funding will extend the project for another year. The project has encountered challenges scaling the technology from the laboratory to the field. Field results so far have not been positive for passivating weathered materials. Better results have been obtained for freshly excavated materials, which will constitute the focus of the next phase of work.

Placer Dome Inc. is funding this project and providing the results to INAP.

### ***Dry Covers***

Dry cover systems are one of the most common preventative measures used to control acid rock drainage. However full-scale application of dry cover

system technology is relatively new. There is a need to improve the mining industry's ability to accurately predict the long-term performance of covers. The objective of the dry covers project is to study the long-term stability of dry covers through a desk study to:

- Identify and define factors that affect long-term performance;
- Evaluate state-of-the-art tools for modelling dry cover systems;
- Provide recommendations for improving existing models and validating them through the measurement of process fundamentals;
- Evaluate dry cover system field performance data from 3-5 sites and select one for field performance modelling.

O'Kane Consultants Inc. is conducting the study with direction from Dr. Lee Barbour, Department of Civil Engineering at the University of Saskatchewan, Canada. The project began in March 2002 and was completed in December 2002, the report is expected in February, 2003.

A field component has been added to the project that includes measurement of field hydraulic conductivity at the Equity Silver Mine, the Kimberley Operations, and a site included as a blind study located in Montana, USA. The fieldwork has added value to the study by identifying a change in a key material property at the sites and allowing evaluation of the processes that caused it.

### ***Rum Jungle Waste Rock Cover***

The design, construction, and monitoring of the Rum Jungle covers have been well documented since their placement 18 years ago in Northern Territory, Australia. In the last few years, lysimeter measurements have indicated that water infiltration has increased significantly. Rum Jungle offers a special opportunity to understand the medium-term behaviour of covers and provide important lessons for their design, use and long-term risk.

Between February and December 2002, a project was funded by INAP to determine the reasons for the deterioration of the cover. ANSTO and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) carried out the work, managed by ACMER. Five criteria were assessed: design, construction, cover materials, physico-chemical characteristics and biological characteristics. The report is expected in the next month.

Findings from the first site visit at the end of the rainy season indicated that construction of the covers, drains and erosion prevention features were generally in accordance with design specifications. No major changes to the mineralogy of the cover materials was found, but physical and geotechnical testing indicate that the cover materials do not meet the original specifications. The permeability has increased by several orders of magnitude, which would explain the greater water infiltration into the dump. The increased permeability is found to be mostly due to biological processes - galleries formed by termites and ants, and root growth from pasture grasses and volunteer trees.

The OpCom approved an extension of the study to the end of the dry season in October 2002. The dry season site visit allowed for the examination of changes to the biophysical characteristics resulting from high temperatures and desiccation. Permeability, oxygen flux, moisture content, chemical profile, desiccation cracks, changes to blocky structure and biological activity were observed.

### ***Treatment of Sulphate in Mine Effluents***

Lorax has undertaken a literature review of the state-of-the-art treatment processes designed to reduce the concentrations of sulphate and metals in mine effluents. The study began in September 2002 and includes a summary of the regulations and guidelines from various agencies around the world with respect to sulphate.

The literature review describes the different methods for removing sulphate and metals from mine effluents. The operating costs of the different methods are provided when available, and case studies of successful operations are documented. The findings were presented at an acid drainage workshop in Vancouver in December 2002. A report will be available by the end of January 2003.

### **10. Next Newsletter**

The next newsletter will be prepared following the meeting in Elko in March, 2003.