

Mining and the Environment II / L'exploitation minière et l'environnement II: An Integrated Approach to Planning and Rehabilitation for the Future

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CONFERENCE REPORT



Sudbury '99

Mining and the Environment II L'exploitation minière et l'environnement II: An Integrated Approach to Planning and Rehabilitation for the Future

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INTRODUCTION

Sudbury '99 – Mining and the Environment II (September 1999) follows on from the success of the original Sudbury '95 — Mining and the Environment conference. The 1995 conference was

an international technical meeting to bring together experts to address mine rehabilitation and related environmental protection methods. The 1995 conference was conceived and organized in response to an increasing demand for development of cost-effective strategies to permanently decommission mines in an environmentally friendly manner. Sudbury '95 was a great success. It not only showcased a major mining centre in Canada but also showed how rehabilitation had succeeded in the "re-greening of Sudbury." More than 500 delegates attended to listen to over 125 presentations, which were captured in a three-set Proceedings volume (Hynes and Blanchette, 1995). The second conference was initially scheduled for May 1999; however, in order to avoid conflict with the Sudbury '99 GAC-MAC annual meeting, the conference was rescheduled to 12-15 September 1999. Approximately 370 delegates descended upon Sudbury to engage in renewed discussion on rehabilitation methods and technologies that have emerged since the first conference.

THE CONFERENCE

The technical program of the conference was divided into three concurrent sessions, presented in three time periods over the three days. Six themes covered important aspects of environmental management in mining, building upon the framework set in Sudbury '95. Each session contained either three (11:00-12:00) or six (8:30-10:30; 13:30-15:30) papers. Presentations were 15 minutes long and questions were reserved for a 15-30 minute discussion period at the end of each set of talks. This practice was enforced by session chairs on day one, and less strictly on subsequent days. In some sessions, the questions and group discussion were

interesting and lively, in others the response was less enthusiastic. There was ample time for further discourse over coffee (30 minutes) and lunch (90 minutes) and sufficient time during and after the technical sessions to visit the Trade Show. The conference was rounded out by a series of pre-meeting short courses, post-meeting field trips, and two mini (free) workshops.

Mining and Society covered a wide variety of topics including decommissioning, closure planning, rehabilitation, environmental effects monitoring, regulations, and spill response. Details were presented on the need for economic diversification in mining communities when faced with closure (Elliott Lake), balancing the need for greater access to resources and more protected areas for parks, strategies for reclaiming and re-using land, and the tools that can be used to carry out environmental effects monitoring (EEM). The majority (17) of papers focussed on case studies and investigations in Ontario and elsewhere in Canada; others were international. In all there were 23 presentations, and 21 of these appear in volume III of the Proceedings (Goldsack *et al.*, 1999) which also contains one additional paper, not presented.

Ecosystems-Health Evaluation and Restoration Technologies focussed mainly on field-related studies of remediated sites. Successes in reclamation have occurred through the use of revegetation, soil bioengineering, constructed wetlands, catchment liming methodologies, and reduction in stack emissions. Risk assessment and management systems were discussed, and one paper provided an estimate of the cost of ecological damage from mining uranium for about 40 years in Ronneburg, Germany,

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based on probabilistic models. This session was the highlight of this conference as was shown by the attendance (in excess of 100 delegates in each presentation period). It was clearly demonstrated that for geoscientists to become involved in the post-closure and remediation end of the mining business, a clear understanding of biological components of the system is essential. Slightly more than half of the presentations were Canadian-based studies. There were 20 presentations, and all papers are contained in volume II of the Proceedings.

New Technologies—Old Problems presented various ways to characterize, measure, remove, contain, mitigate, and inhibit metal leaching from mining materials. Some of the ways are physical, as in engineered barriers such as frozen earth dams or geocell mattresses, whereas others make use of chemical methods, such as passivation techniques (*i.e.*, coating to prevent oxidation) with added inorganic or organic compounds. A new water-sampling technology (Diffusive Gradients in Thin-Films, DGT) is now available to measure free ion activity, and is being tested as a means to assess bioavailability of metals. New uses for paste technologies are also being developed; for example, to serve as a plant growth medium. There were 24 talks presented, of which two are not contained in the Proceedings and one is found in volume I, under Acidic Drainage. There are three additional papers in the Proceedings.

Acidic Drainage covered all aspects of current activities related to field, laboratory, and modelling studies. These ranged from *in situ* studies of dry and wet covers to detailed mineralogy and geochemistry, and the use of a variety of newer and older computer codes to understand the generation and prevention of acid rock drainage (ARD). This theme formed the largest part of the conference, notably because it is the most deleterious aspect of metal mining in Canada and internationally. There were strong recommendations to control ARD through complete submergence. About half of the papers discussed research carried out solely in Canada, although Canadian researchers are also active internationally. There were 32 talks presented, of which one

is not in the Proceedings volume and one is found in volume II, under Ground and Surface Water Remediation. There are three additional papers in the Proceedings, not presented at the conference.

Ground and Surface Water Remediation was a complementary session to Ecosystems-Health Evaluation and Restoration Technologies. This session examined quality of ground, surface, and pore waters associated with wetlands, tailings impoundments, and underground excavations. It also looked at methods to attenuate metal movement through emplacement of permeable reactive barriers and wet and dry covers. Some papers showed that geochemical models are useful in planning management systems for water treatment. Slightly more than half of the presentations were based on Canadian studies. There were 26 presentations, of which one paper is not in the Proceedings. There is one additional paper and one is included in the Acidic Drainage section of the Proceedings.

Environmental Data Management is a new theme for this conference series and captures an important aspect of all scientific research, that of data management. The six papers presented cover a variety of aspects from capturing historical and archived data (*e.g.*, over the course of 150 years) on all aspects of mine operations, to environmental monitoring systems that can capture and use data for defining statistical trends, to an international data base on static testing (*e.g.*, acid-base accounting) that will facilitate examination of ARD problems globally. This is a current focus of geoscience institutions and its importance was exemplified in this session. All six papers appear in the Proceedings.

SHORT COURSES

Four pre-conference short courses were presented. The first course "Assessment and Management of Risks Associated with Metal Leaching and Acid Rock Drainage at Mine Sites" was co-ordinated by Gilles Tremblay (CANMET) under the auspices of MEND 2000 (Mine Environment Neutral Drainage Program). This full-day course addressed the topic of risk assessment, including risk assessment principles, ecological risk, and application of risk assessment to metal leaching and ARD. Case stud-

ies and regulatory aspects were discussed.

The second 1-day course entitled "Case Studies on Wet and Dry Covers for Tailings and Waste Rock," also organized and co-ordinated by Gilles Tremblay, provided participants with a brief review of the technical principles associated with the application of both wet and dry covers over tailings and waste rock. The main focus, however, was on case studies that illustrated cover design and performance from planning and conception through to monitoring and reporting. Copies of the MEND 2000 short course notes can be purchased from the MEND Secretariat at <http://mend2000.NRC.gc.ca>.

The third short course, one-half day, on "Aquatic Effects Technical Evaluation (AETE) Program: The ABC's of the Aquatic Impact Assessment 'Toolbox'" was co-ordinated by Joanne Papineau (CANMET) with presentations by members of ESG International. This course described the fundamental components of an environmental effects monitoring (EEM) program that can be used to assess the potential aquatic effects of mining activities. The focus was on the application, utility, and integration of the various tools in the mining assessment toolbox, with specific reference to field and laboratory studies and technical reviews. The final course, also a half-day course, on "Tailings Guidelines-Mining Association of Canada" was co-ordinated by Elizabeth Gardiner (MAC). This course introduced the new MAC-sponsored guidebook called "A Guide to the Management of Tailings Facilities." A comprehensive tailings management system, from initial site selection and design, through construction and operation, to eventual decommissioning and closure, is defined in the guidebook. This will allow companies to meet the challenges of environmental responsibility by integrating environmental and safety considerations into tailings operations.

FIELD TRIPS

There were five field trips provided to participants. They encompassed a "cradle to grave" look at mining and current practices in decommissioning and rehabilitation. There was a local tour of operating mine sites (Environmental Management at Falconbridge and Inco) where delegates toured the Falconbridge Smelter Complex, highlighting

the unique reclamation methods being used at the facility. They also toured the Inco Copper Cliff tailings area, showing on-going reclamation efforts and agricultural methods being used. This was the most popular field trip.

The next most popular field trip was to see the Elliot Lake Uranium Mine Decommissioning Program in action. Rio Algom Limited and Denison Mines Limited have largely completed decommissioning activities at their mine sites. With their activities nearly complete, the mining companies are shifting their focus to long-term monitoring, care, and maintenance of these sites. In particular, they have moved in the direction of automation for their effluent treatment, data acquisition, supervisory control, and remote monitoring.

The Timmins, Kirkland Lake and Cobalt Mine Rehabilitation field trip was aimed at seeing the various stages of rehabilitation at abandoned, closed, and operating mine sites, acid mine drainage characteristics (Kam-Kotia Mine), thickened tailings-cone waste management scheme (Kidd Creek Metallurgical Complex), and examination of mine subsidence. Recent attempts at rehabilitation in the Kirkland Lake and Cobalt areas were also included. This trip appealed more to the international delegates, as a vanload trekked north.

Two day trips included "The Greening of Sudbury" and "Killarney Provincial Park, Recovery of Acid-Damaged Lakes." During "The Greening of Sudbury" tour, participants visited a variety of sites within the 3200 hectares that have been revegetated with more than 5.5 million trees over the past 15 years (latest figure according to Dan Napier of The Regional Municipality of Sudbury, personal communication, November 1999). The success of this award-winning program lies in the development of species diversity and improved water quality and fish habitat in lakes through liming of the surrounding terrain. The Killarney trip was designed to interest accompanying persons at the conference. The trip was to document the acid rain story, discover how lakes were recovering and view some of the clearest lakes (20-30 m in depth). In addition, the beautiful scenery and autumn colours could be enjoyed, and the possibility of seeing wildlife anticipated.

WORKSHOPS

On the Tuesday evening two concurrent

free workshops were offered to the delegates. The first concerned Space Technology and the second, an orientation session on the Mining Environment Data Base housed at Laurentian University. We attended the "Space Technologies Transfer Opportunities in Environmental Mining" workshop along with about 60 other delegates. This workshop was hosted by MIRARCO (Mining Innovation, Rehabilitation and Applied Research Corporation; a research consortium between Laurentian University, private companies and public sector), sponsored by the European Space Agency (ESA), and chaired by Dougal McCreath (Elliot Lake Research Field Station).

The workshop highlighted three theme talks by experts from three different industry sectors. Gudrun Weirum outlined ESA's research program related to earth observation using a variety of satellite systems. They currently have a co-operative agreement with Canada, in particular with MIRARCO. Environmental monitoring conducted so far is more or less related to global warming (e.g., ozone depletion) and natural hazards. However, new instruments can use radar, microwave, and infrared spectra to look at surface waters, wind speeds, etc. Ross Gallingier from Rio Algom Limited outlined the various monitoring requirements of a mining project (pre-operational, operational and closure). He noted that automated systems are becoming popular to remotely monitor air quality and water quality, sound alarms, and upgrade reports, and that there is potential to use more satellite imagery. Ted Nolan (Ontario Forestry Research Institute) finished the theme talks by discussing how airborne and satellite instrumentation has been used to monitor forest fires and spread of diseases in vegetation. The important aspect to consider is resolution (spatial, spectral and temporal). For example, the LANDSAT enhanced thematic mapper has a spatial resolution of 15-30 m. Comments and perspectives were then given by three invited participants who are in the business of serving the mining industry: Nelson Belzile (Elliot Lake Research Field Station), Darrell McClarty (Envista Technologies), and Fred Baker (Mine Waste Management Inc.). These speakers, and comments from the audience, echoed the need for developing technologies/instruments that can ac-

curately monitor field parameters and transmit the information in real time. The current status of technology development was reviewed. Application of satellite imagery to geological mapping (lithology and alteration patterns) and monitoring stability of geotechnical structures was also discussed.

The second workshop was an orientation session on the Mining Environment Data Base that is housed at Laurentian University in Sudbury. This data base, the largest of this kind in the world, contains 22,000 citations to journal articles, conference papers, book chapters, and government and consultants' reports. Data base search is free and can be done through the Laurentian Library's webpage: (<http://www.laurentian.ca/www/library/medlib.htm>).

TRADE SHOW

There was ample time for delegates to peruse the many facets of the Trade Show during the three days. In all, 39 companies, research institutions, and government departments displayed their equipment, software, and publications related to mine rehabilitation and environmental protection, products, and services.

PROCEEDINGS

Delegates were given a choice as to what type of Proceedings they wanted. The traditional hard copy version contained three volumes (noted above) with a total of 1270 pages and a combined weight of 3.45 kg. Alternatively, one could take the slim, light-weight CD-Rom version (~100 g). The CD version contains scanned versions of the camera-ready papers which is searchable using Adobe Acrobat®. The advantage of the CD version is that the papers contained in the 1995 Proceedings were also scanned (sometimes a little crookedly) and captured for the 1999 conference.

ABANDONED MINE SITES ANNOUNCEMENT

To culminate the end of the conference, the Honourable Tim Hudak, Ontario Minister of Northern Development and Mines, announced that Ontario would provide \$27 million to rehabilitate abandoned mine sites. Mr. Hudak noted that the clean-up of many sites will allow land to be reused for other purposes, such as recreational and community activities, or redeveloped for economic

purposes (e.g., mineral exploration). Work was to begin immediately on securing up to 30 open shafts and other physical hazards on a variety of sites. Work would extend over a 4-year period. This announcement was met with great applause from the delegates in attendance.

CONCLUSIONS

Sudbury '99, Mining and The Environment II conference experienced a reduction in the attendance from the 1995 conference. This was at least in part a reflection of the current state of the mining economy. Still, the conference was a worthwhile meeting and is expected to be repeated in the future. We recommend changing the current presentation format to accommodate questions following each talk, similar to most meetings (15-20 minutes, including questions). Discussions at the end of each session, however, should continue. Mining involves the exploitation of natural mineral resources and disturbance of geologic material, therefore, more geoscientists should be encouraged to participate in these types of conferences.

Copies of the Proceedings (hard copy or CD; C\$90 including shipping) can be obtained from CIMMER (Centre in Mining and Mining Environment Research), Laurentian University, Ramsey Lake Road, Sudbury, ON, P3E 2C6 (tel: 705-673-6572; fax: 705-673-6508). The contact person is Charlotte Mosher (cmosher@nickel.laurentian.ca).

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