

**Priorities and Knowledge Gaps for a New National
Metals Research Network**

KINGSTON WORKSHOP REPORT

MAY 26-27, 2003

DONALD GORDON CENTRE

QUEEN'S UNIVERSITY

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WORKSHOP INTRODUCTION AND GOALS

Workshop Sponsors: The Mining Association of Canada and the MITE-RN

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Workshop Facilitator: Frank Van Gool, Intersol

Workshop Proceedings Recorder: Peter Chapman, EVS Environment Consultants,
Vancouver

Workshop Format: Plenary sessions, break out groups, and discussions

Workshop Objectives:

- (1) Identify current national and international knowledge gaps and research priorities that will form the basis of the new Network application, as described under "Workshop Product".
- (2) Obtain suggestions from stakeholders to define collaborations for the new Network.
- (3) Identify recommended research themes or domains
- (4) Identify member organizations with representation on a proposal steering committee, who will:
 - After receiving the workshop report, participate in an approach that will be utilized to identify and engage collaborators.
 - Prepare material to be included in a Preliminary Application to NSERC for a metals research network to investigate the impact of metals in the environment, with specific emphasis on the role of environmental contamination as a source of exposure for humans, based on the Workshop proceedings.
 - If invited to submit a full proposal to NSERC, prepare this proposal, seeking input from identified sponsors, as required.

AGENDA**DAY I: Monday, May 26/2003 (9 a.m. to 6 p.m.)**

- | | |
|--|------------------|
| 1. Welcome | Peter Campbell |
| 2. Introductions. Charge to Workshop participants | Frank Van Gool |
| 3. Research priorities as identified by Stakeholders | |
| - Mining Association of Canada | Bruce Conard |
| - Ontario Power Generation | Robert Kozopas |
| - Agrium | Michelle Nutting |
| - Agriculture Agri-food Canada | John Richards |
| - Health Canada (food) | Gerry Cooke |
| - Environment Canada (CEPA Risk Assessment) | Pat Doyle |
| - Health Canada (non-Food) | Mike Inskip |
| - Natural Resources Canada (GSC-MITE) | Andy Rencz |
| - Fisheries and Oceans Canada (Fresh Water Institute) | Jack Klaverkamp |
| - Environment Canada (National Guidelines and Standards) | Uwe Schneider |
| Workshop planning committee – evening meeting | (See Appendix C) |

DAY II: Tuesday, May 27/2003 (8:30 a.m. to 4:00 p.m.)

1. Summary of main points raised during Day 1; identification of common / consensus priorities
2. Identification of recommended research themes or domains
3. Discussion of Network organization (partners; principal investigator; domain or theme leaders; participants; links to other related research networks; etc.)
4. Steering Committee (role, composition, schedule)
5. Wrap-up Session (next steps; preliminary application to NSERC)

3. GROUP PICTURE OF PARTICIPANTS



KINGSTON WORKSHOP PARTICIPANTS

(Front row; left to right) Jackie Scott, Lorraine Seed, Peter Chapman, Michelle Nutting, Beverley Hale
(2nd row, left to right) Gwendy Hall, Bob Kozopas, Donna Warner, Justyna Laurie-Lean, Cathy Banic
(3rd row, left to right) Len Ritter, Gerry Cooke, Pat Doyle, Uwe Schneider, W. Hendershot, Robert Prairie, Uwe Borgmann,
(4th row, left to right) Andy Rencz, Eugene Gawalko, Shaheer Mikhail, Chris Wood, Robert Telewiak, Bob Garrett
(5th row, left to right) Rod Allan, Mike Inskip, Jack Klaverkamp, John Richards, Peter Campbell, Evert Nieboer, Bruce Conard

4. IDENTIFYING KNOWLEDGE GAPS AND RESEARCH PRIORITIES

In order for the Workshop to capture knowledge gaps and potential research priorities, a number of key stakeholders from industry and government were asked to prepare brief presentations regarding their respective organizations. Further guidance to speakers was provided by means of the scheme, shown below in Appendix B, depicting the interrelationship between the aquatic environment, the terrestrial environment, and the role of contamination of various environmental media as a potential source of human exposure. In addition, in order to foster the greatest possible opportunity for cross fertilization among various public and private interests in developing the priorities for the new Network, speakers were encouraged to develop the issues in as broad a context as possible, thereby facilitating the identification of issues of greatest common interest. Specifically, invited speakers were asked to address the following points in their presentations.

- A general introduction describing their organization's priorities with respect to research, surveillance, and risk assessment pertaining to metals.
- Some sector specific key data gaps (e.g. speciation, bio-availability, interactions among metals, human exposure determinations/epidemiology) that may be impeding the risk assessment process as it relates to the potential impact of metals in the environment, with specific emphasis on the role of environmental contamination as a source of exposure for humans.
- Concerns regarding deficiencies in the current state of toxicology research on metals.

5. WORKING GROUPS

(Working group participants identified in appendix D)

Day 2 of the workshop was devoted to refinement of the broad research needs and priorities presented by various stakeholders during the Day 1 plenary presentations from key industry and government collaborators. Recognizing that the breadth of the issues presented went well beyond what could be developed as a basis for a Network research program, a sub-committee of workshop participants was struck to develop ranking criteria by which the broad interests and issues presented on Day 1 could be distilled into a coherent multi-disciplinary research program. Sub-committee members (see Appendix C), guided by the environmental and human exposure compartments identified in Appendix B, developed the following criteria, which became the basis on which working groups identified the most relevant and highest research priorities.

5.1 Criteria For Setting Research Priorities

- Potential for leveraging the proposed research priority with existing research activities of Network partners
- National relevance of the proposed priority (rather than site-specific)
- Relevance to policy development in the metals area
- Potential to bridge the interface between environment and human health
- Contribution to both human health risk assessment and ecological risk assessment
- Meets research needs of new partners
- Addresses evident knowledge gaps characterized by few data to date; focusing on reducing key uncertainties
- Recognizes and complements international efforts
- Exciting research, curiosity- as well as policy-driven, able to attract and retain top Canadian investigators
- Addresses key issues related to inter/multi disciplinary research that would best benefit from the proposed Network approach
- [Feasibility and cost – considered afterwards]

5.2 Proposed List Of Research Gaps Identified By Work Groups

5.2.1 *Ecological: water and sediments*

- Bioavailability/bioreactivity (includes speciation, bio-accessibility, ageing for sediments; FIAM/BLM models)
- Acclimation/adaptation (effects on PNECs)
- Differences between marine and freshwater
- Mixtures (metal-metal and metal-organics)
- Synergistic and antagonistic effects
- Critical body/tissue concentrations relative to biota toxicity (via food and water)
- Sediment quality guidelines (lab vs. field data)
- Toxicity data for data poor metals – how to determine maximum permissible loading rates in absence of robust PNEC estimates
- Trophic transfer (ecological impacts of diet-borne metals)
- Natural attenuation (sediments)

5.2.2 *Humans: water and sediments*

- Fish (Hg)
- Shellfish (Cd)
- Bioreactivity (bioavailability from food)
- Effect of mineral composition of diet on bioavailability of ingested metals

5.2.3 *Humans and ecological: air*

- Speciation of particulates with reference to fate in lungs – bioavailability and tumors
- Diffuse vs. point sources, apportionment for metals in atmospheric particulates
- Ambient air monitoring including point sources/critical loadings
- Metals-in-air criteria for human health based on plant sensitivity to aerial deposition – presumably because the plant criterion is stricter, but is it relevant? How many metals/air criteria are set this way (i.e., with poor attention to bio-availability)?

5.2.4 *Ecological: soil*

- Bioavailability across soil types (includes ageing + soil mineral composition; FIAM/BLM models; speciation; sequential leaching)
- Metal partitioning to soil solid phases (kinetics, thermodynamics, Kd)
- Plant uptake factors (genetics)
- Improved predictions of metal uptake to plants from soil data (soil to roots is one thing, soil to shoots is more difficult)
- Mixtures (metal-metal and metal-organics)
- Toxicity data for data-poor metals – how to determine maximum permissible loading rates in absence of robust PNEC estimates
- Effects of metals on soil micro-flora (long-term sustained additions)
- Movement from the terrestrial ecosystem to aquatic environments
- Natural attenuation (soils)

5.2.5 *Humans: soil*

- Dermal absorption
- Ingestion rates of metals from soils and bio-availability
- Better data on normal dietary intake of metals (types of food and metal content of that food)
- Bio-availability (speciation, bio-reactivity, bio-accessibility) of metals in supermarket products relative to produce from backyard gardens
- Metals in export commodities and role of re-processing
- *In vitro*, *in vivo* methods for estimating bio-availability for soil to plant to mammalian target organs
- GI absorption of foods and soils and modifying factors
- Accurate RfDs for different population subsets
- Source apportionment re. intake: food, water, air, other (e.g., soil, smoke from cigarettes)
- Effect of mineral composition of diet on bioavailability of ingested metals

6. GENERIC ISSUES

In addition to specific issues, participants were asked to develop more general, cross cutting generic issues. Participants identified the following generic issues:

- Further study of the movement of metals within the ecosystem
- Defining background concentrations (effects on PNECs)
- The development of application factors (better way to capture uncertainty probabilistically; understanding the impact on PNEC where estimates are less than background concentrations)
- The need to ensure the relevance of the research through field validation.
- Validation of the relationship between adverse health effects and biologically relevant exposure
- The need to address knowledge deficiencies related to urban brown fields
- The need to address important knowledge gaps related to the federal government's "domestic substances list (DSL)" appraisal process, with specific reference to the solubility and reactivity of pure compounds in simulated natural waters
- The importance of addressing metals (e.g., As, Tl, Be, Se, Al, Mo, Sb, Ag, organometals) not previously studied under the MITE-RN
- The need to ensure ongoing critical appraisal and quality of the scientific evidence
- Data mining to ensure the maximum value for the research investment
- The need to recognize life cycle analysis in the risk analysis component of the proposed research network (including generic *vs.* specific issues for individual metals)
- Integration of environmental and human health risk assessment
- The need to identify and specifically include susceptible populations that may be at particular risk of adverse effects, including identification of adverse effects that may be specifically related to routes of exposure (e.g., groundwater, ethnic foods), etc.
- The need to ensure that risk communication to various stakeholders is appropriately recognized as a priority

7. NETWORK ORGANIZATION

Workshop participants discussed the advantages of a "network" approach. Participants noted the opportunity that a Network affords to bring together otherwise diverse public and private interests in a multidisciplinary approach to resolve common issues related to environmental contamination by metals, and the importance of environmental contamination as a source of human exposure to metals. Workshop participants agreed that the following elements would be critical to the organization and success of the proposed Network:

- Establish links with other networks that already have strong research interests related to adverse health effects from exposure of humans to contaminated environmental compartments, including sources of food. Such organizations might include the Institut national de la santé publique du Québec, Quebec City, and the McMaster University Health and Environment Institute.
- In view of the success of the MITE-RN model, participants agreed that the same basic model should be retained in developing the new Network. Important features would include Domains and Domain-Leaders, a Science Steering Committee to monitor and ensure continuing relevance of research goals, and an Expert Advisory Panel responsible for ongoing peer review of scientific excellence.
- Participants agreed on the importance of a risk communication strategy that would include explicit emphasis via a Secretariat, including specialized meetings, interactions with other special interest groups. The federal government's Northern Contaminants Program was suggested as a specific example of a public group with a long-established interest in potential exposure of population subsets, and the importance of communicating with, and through, this group was emphasized. Innovation will be required especially regarding building bridges between organizations that share common interests and objectives. The Workshop participants emphasized the need to engage organizations potentially impacted by metal contamination of the environment and foods in the development of the research plan, as well as in the communication of research results.
- The Workshop participants also noted the importance of international collaboration, including the identification of international partners in the research program.

8. WORKSHOP CONCLUSION

In concluding their discussions, Workshop participants noted the following short-term objectives:

- Workshop participants supported the proposal to seek a five year mandate from NSERC, and collaborating partners, through submission of a "preliminary application" to NSERC in early fall, 2003.
- Workshop participants generally affirmed their commitment to contribute to the preparation of the "preliminary application".
- Workshop participants specifically noted the need to ensure that the new proposal addresses the link between environmental contamination, human exposure and adverse health effects.
- Workshop participants noted the need to ensure that the Network has clear links to policy development and application.
- Workshop participants expressed the importance of ensuring that Canada's leading academic human health researchers be present during development of the Preliminary Application, and that identifying these collaborators is a critical priority in developing the Preliminary Application.

- Workshop participants noted the importance of ensuring that the development of the Preliminary Application, and subsequent full application if advised to do so by NSERC, must include representation from MAC, and the international metals community. In addition, the Workshop suggested that participation from the Aboriginal community be considered as well.

9. NEXT STEPS

The workshop report will be made available to workshop participants and posted on the MITE-RN web site.

- The proposal steering committee will work with the research program partners to prepare a Preliminary Application to NSERC.

10. APPENDICES

10.1 Appendix A: Workshop Attendees

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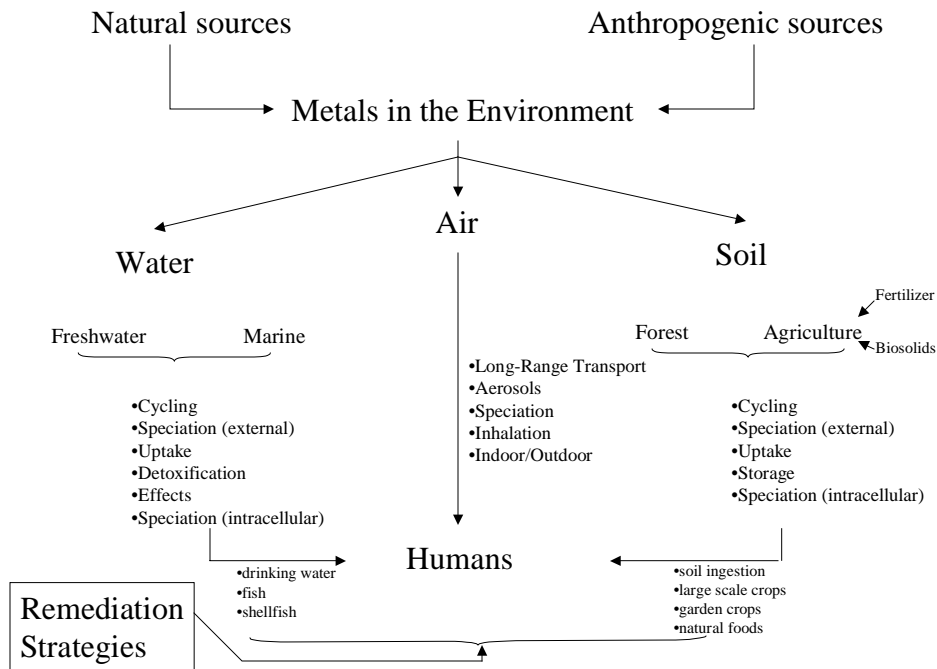
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10.2 Appendix B: Schematic Outlining the Basis of New Proposal



10.3 Appendix C: Workshop Sub-Committee Members

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Donna Warner – MITE-RN Secretariat, University of Guelph

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10.4 Appendix D: Workshop Work Groups

ECOLOGICAL AND HUMAN: WATER AND SEDIMENTS

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HUMANS AND ECOLOGICAL: AIR

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10.5 Appendix E: Glossary of Terms

BLM	Biotic Ligand Model
DSL	Domestic substances list
FIAM	Free-Ion Activity Model
GI	Gastrointestinal (tract)
K _d	Solid-liquid partitioning coefficient ($[M]_{\text{solid}}/[M]_{\text{aqueous}}$)
MAC	Mining Association of Canada
MITE-RN	Metals in the Environment Research Network
PNECs	Predicted No Effect Concentrations
RfD	Reference Dose