MITHE-RN NEWS
WINTER 2005
CANADIAN NETWORK OF TOXICOLOGY CENTRES

BUILDING ON THE PAST – LOOKING TO THE FUTURE

A new research network with a diverse base of industry, government, and academic partners was approved for support by NSERC on January 3, 2005. The official launch of the Metals in the Human Environment Research Network (MITHE-RN) was celebrated at the campus of the University of Guelph on October 24, 2005. The new Network builds on, and further extends, science knowledge developed by the NSERC sponsored Metals in the Environment Research Network (MITE-RN 1999-2004).

The MITHE-RN received a five-year funding award (2004-2009) from NSERC totaling $5.4 million. This award includes cash and "in-kind" contributions from Agriculture and Agri-food Canada, Health Canada, Natural Resources Canada, Environment Canada, the Ontario Ministry of the Environment, Ministry of Agriculture, Food and Rural Affairs, the Canadian Grain Commission, the Potash & Phosphate Institute of Canada, the Mining Association of Canada, the Ecotoxicity Technical Advisory Panel (ETAP member companies are: International Lead Zinc Research Organization, the International Copper Association Ltd., the Nickel Producers' Environmental Research Association, the Cobalt Development Association, US Borax, and the International Council on Mining and Metals), Terratec Environmental – an American Water Services Company and Jacques Whitford Environment Limited.

The MITHE Research Network is led by Dr. Beverley Hale, University of Guelph, and is supported by a Secretariat managed by Dr. Len Ritter, Executive Director of the Canadian Network of Toxicology Centres. The MITHE research program will address the key uncertainties that hamper site-specific risk assessments for metals in surficial environments. The basis for the Network's science plan is that dust,

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In This Issue

(left to right) Dr. Alastair Summerlee, Dr. Beverley Hale, Mr. Ted Bilyea, and Dr. Len Ritter

AQUATIC ECOSYSTEM THEME

Theme Summary

Aquatic ecosystems are recognized to be sensitive to metal inputs, whether the metals enter via the atmosphere, as wet or dry deposition, or from the terrestrial catchment via diffuse surface runoff or point source effluents in the form of dissolved and particulate loadings. Because of this inherent sensitivity, environmental regulators and managers have tended to focus on the aquatic environment when assessing the environmental risks associated with metal extraction, refining, and use. However, all aquatic ecosystems are not equally sensitive to metal inputs. Methods used for regional or site-specific ecological risk assessments must take into account the characteristics of the receiving waters (e.g., pH, salinity, hardness, alkalinity, concentrations of organic matter and reduced sulphur species). Aquatic ecosystems also differ in their sensitivity to metal inputs for biological reasons, i.e., because of differences in their resident aquatic communities.

Research conducted under the Aquatic theme will focus on protecting the health of freshwater ecosystems, as their continued productivity is critical to recreational use of water, its direct consumption, and as a source of food. The goal of this theme is to provide a sound scientific basis for protecting the environment from metal contamination without unduly restricting human economic activities. Metals and metalloids being measured under this theme's research program are: Cd, Co, Cu, Hg, Ni, Pb, Tl, Se and U.

The Aquatic Ecosystem theme contributions to the Environment & Human Health Risk Assessment (E & HHRA) framework are:

A1 Provide important tools to industrial environmental managers, government regulators, and environmental scientists that will maximize the predictive power of metal toxicity models.

A2 Improve our ability to predict the effects of metals and metal mixtures.

A3 Develop tools to reduce the uncertainties associated with measuring the long-term impacts of mine effluents on a site-specific basis.

A4 Determine if current water quality criteria for the protection of aquatic life, based on water-only studies, are sufficiently protective of aquatic ecosystems where organisms obtain metals not just from water, but also from food and sediments; provide data for setting sediment quality guidelines.

A5 Address the question of whether metal burdens attained from waterborne and diet-borne metals have similar effects on the consuming organism in order to explain and predict trends in metal concentrations and effects along food webs.

A6 Determine the concentrations and speciation of Se in the aquatic environment, specifically in Western Canada where mining activities and irrigation could contribute to Se loading, and relate these data to bioavailability.

A7 Identify sources of Se contamination to determine if Se burdens in waterfowl (in combination with other pollutants) are causing impaired reproduction and/or survival, and predict if this contamination could influence regional or continental populations.

Theme leaders are: Peter Campbell (INRS-ETE), and Uwe Borgmann (Environment Canada). Research summaries and researcher contact information for the seven projects conducted under this theme may be viewed on the MITHE-RN web site at: http://www.mithe-rn.org/research/aquatic/index.cfm ❡

SOILS & PLANTS THEME

Theme Summary

While much is known about acute exposure of soil organisms to metals, the effects of long-term sustained metal additions on soil functions are not well understood, and constitute a research priority under Soils and Plants. Assessing and managing the risk associated with potentially toxic trace metals and metalloids in soils requires good scientific knowledge of their behaviour in the terrestrial ecosystem.

This research theme will address the movement of trace elements from agricultural soils into food (for animals or humans). Two research foci have been developed, one dealing with the problems encountered in western Canada where the main problem is the accumulation of Cd from parent materials or fertilizers in the edible seeds of cereal crops, and the other dealing with agricultural soils of eastern Canada where a range of metals or metalloid compounds, with potential for toxicity, have been added to soils by human activity.

The goal of this theme is to provide Canadian regulators and environmental managers with scientific data that may be used for developing scientifically defensible soil quality guidelines that can be applied in site-specific risk assessments. Metals and metalloids being measured in this theme's research are: Cd, Ni, Co, Cu, Zn, Mn, Se, and As.

The Soils & Plants theme contributions to the E & HHRA framework are:

S1 Strategies to reduce content of potentially harmful trace elements in crops, or conversely, to increase the content of nutritionally beneficial trace elements that may have important effects on human health.

S2 Provide predictive models to allow regulators to use site-specific measurements of trace element bioaccessibility as a tool in decision making and site management.

Theme leaders are: William Hendershot (McGill Univ.) and Andrew Rencz (GSC-NRCan). Research summaries and researcher contact information for the two research projects conducted under this theme may be viewed at: http://www.mithe-rn.org/research/soils/index.cfm ¶

FOODS & INGESTED PARTICLES THEME

Theme Summary

The Ingesteds theme addresses the exposure of humans to metals via dust, soils, and food. The research will focus on the potential for Canadians to be exposed to metals through diet and inhalation, i.e., food and ingested non-food particles (e.g., soil, house-dust, paint particles). As most Canadians are not occupationally exposed to metals, ingestion constitutes the exposure route of greatest importance. Understanding the relative roles of soils, dust, and food in this exposure is a very important aspect of risk assessment. Without this information, the most effective risk management options cannot be recommended.

The projects under the Ingesteds theme are linked to international efforts to estimate bioavailable fractions of ingested metals. The BioAvailability Research Group of Europe's (BARGE) efforts towards this goal are focused on soil, and the Ingesteds work is linked to BARGE through the participation of Ollson in both teams. Research from this theme will also contribute to the current risk assessments ongoing in several communities in Canada. Metals and metalloids being measured under this theme's research are: Fe, Ni, Cu, Zn, Mn, Co, Pb, Cd, As, Co, Hg, Tl, and V.

The Foods & Ingested Particles theme contributions to the E & HHRA framework are:

I1 To investigate concerns about poor air quality in the Windsor-Detroit region which have led to a number of health effects studies being conducted by Health Canada on air quality. This study was undertaken to support the Border Air Quality Strategy, an international agreement, between the governments of Canada and the US.

I2 Produce results to help guide policy-makers to make decisions about land use, public access, and future risk assessments regarding regulations pertaining to exposure by humans, including children, to arsenic levels in tailings-associated soil that exceed soil guidelines.

I3 Produce findings to allow a better estimation of metal toxicity to the lungs following long term exposure to low metal levels, i.e., a better knowledge of subtle chronic toxic effects that may affect optimal lung function without necessarily producing gross toxicity.

I4 Generate knowledge regarding the bioaccessibility of metals which will allow regulators to set more accurate food consumption guidelines that minimize risk to human communities. By learning of potential differences in metal exposure between foodstuffs, people may limit intake of the most hazardous types of foods.

I5 Generate findings to confirm or refute the suitability of 100% as the default assumption for bioavailability of ingested metals. This default value often results in soil ingestion being the driver for risk assessment. If soil ingestion is not the source of greatest importance, once absorption is taken into account, then there is a chance that the remediation strategy will not reduce risk, which could result in high costs borne by society as well as the party undertaking the cleanup.

I6 Provide input on how much and what type of arsenic Canadians are ingesting from common food items. This information will help reduce the main sources of exposure to toxic arsenic species, thereby protecting public health.

I7 Provide information on characterizing the impact of exposure to metals/metalloids on mutagenesis and highlight sources and pathways of exposure to metals that may be targets for preventive action.

Theme leaders are: Beverley Hale (University of Guelph) and Robert Garrett (GSC-NRCan). Research summaries and researcher contact information for the seven projects under this theme may be viewed at: http://www.mithe-rn.org/research/ingesteds/index.cfm ❡

ENVIRONMENT & HUMAN HEALTH RISK ASSESSMENT

The Network has recruited a team of three highly qualified and experienced risk assessors to supervise the integration of the MITHE-RN's results into the framework for risk assessment: Evert Nieboer, Team Leader (McMaster University and the University of Tromsø, Norway), Steve Sheppard (ECOMatters Inc.), and Peter Chapman (Golder Associates Ltd.). These three individuals have combined expertise in risk assessment for human populations (Nieboer), terrestrial ecosystems (Sheppard), and aquatic ecosystems (Chapman). They are responsible for ensuring that the MITHE-RN addresses the risk assessment priorities of all of our partners by providing continuous assessment of individual projects to ensure that their potential contribution to E & HHRA is fully realized by:

- Ensuring E & HHRA linkages are evident in papers by the MITHE-RN researchers submitted to discipline-specific journals and the Human and Ecological Risk Assessment (HERA) Journal; and preparation of a joint integrative paper by Nieboer, Chapman, and Sheppard.

- Preparing and updating, annually, a tabular summary for each Network project that lists subject metals, other elemental species with which they are likely to interact, experimental approaches, relationships to anticipated findings for E & HHRA, and anticipated usefulness of the findings to regulators and non-scientists.

- Development of Science Briefs that highlight Network results and summarize results of other metals research data.

- Supervising deliverables from the MITHE-RN Risk Assessment (RA) Intern Program. Two Risk Assessment (RA) interns will be placed in organizations with the specific objective of liaising between the MITHE-RN activities and the RA objectives of the respective organizations.

- Presenting E & HHRA information at our annual symposia and providing input into the metals risk communication session scheduled for our January 2006 research symposium.

- Assisting MITHE-RN researchers to develop tools for furthering community-based Risk Assessment (CBRA). Tools developed through MITHE-RN research projects may be applied not only to specific sites where studies are conducted, but also broadly throughout Canada and the world. ❡

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RISK COMMUNICATIONS

Science communications: bridging the gap

With the BSE scare, the SARS crisis, and the threat of a global flu pandemic that some experts argue will kill millions, the need for effective and timely science communications continues to reach new levels. The importance of effective communication, from scientist to society, is becoming strikingly obvious as we all become more concerned with the environment around us.

The importance of scientists communicating among themselves is as important as scientists communicating with the public. Before the information can be disseminated to the public, it must first be understood among the scientific community. This is one reason why it can take so long for information to reach the public, and this is where professional communicators can play a vital role in the process. Professional communicators can serve as the bridge between the scientific community and the general public, especially so when communicators are trained in the sciences and have a firm grasp of the complex concepts they are communicating.

The gap between hard science and public understanding seems to be growing ever greater, all the while that public perception and trust of the scientific community continues to erode. Researchers frequently express frustration with the media who, they argue, have misrepresented their life's work to the general public. While it's natural to expect that the media will serve as a direct channel to the public for a personal perspective on the importance of scientific work, scientists sometimes fail to recognize, or even consider, that the media have their own missions and priorities, and that all too often their priorities are not those of the scientific community. Moreover, as Robert Bazell, Chief Science Correspondent for NBC Nightly News has noted, regular communication between researchers and the media – the source of information for the lay public – can only help improve the quality of information that is transmitted from the research community to the end users of these important advances in knowledge.

Scientific research is important and crucial to our way and quality of life. It is "science" after all that reduces the burden of disease, improves the safety of our food, and provides the basis for the development of evidence-based public policy that protects both human and environmental health while preserving and promoting our economic growth. As scientists, it is essential to communicate the importance of our findings to a broader spectrum of society; when this is achieved, society as a whole benefits. Improving the quality of life has long been number one on the agenda – now let's make public understanding number two. ¶

Mitch Ritter

Mitch Ritter is the Coordinator of SPARK (Students Promoting Awareness of Research Knowledge), Office of Research Communications, University of Guelph

NETWORK NEWS & ANNOUNCEMENTS

Symposia, Conferences, and Workshops

The **2nd annual symposium of the MITHE Research Network** will be held Jan. 24-25/06 at the Château Cartier Resort in Aylmer, Gatineau. The program will include presentations on risk communications by Dr. Joseph Arvai (Risk Assessment Consultant, University of Michigan), and Dr. Paul Schubert (ADM Communications Branch, Agriculture & Agri-Food Canada). Registration details available on web site at: http://www.mithe-rn.org/ann_symp/index.cfm.

The **Federal Contaminated Sites National Workshop** will be held March 7-10/06 at the Crowne Plaza Hotel, Ottawa, Ontario. The federal government has embarked on an ambitious program to address the human health and ecological risks and the significant financial liability related to federal contaminated sites. The Federal Contaminated Sites National Workshop is intended to enable federal managers and technical experts to share information and increase their knowledge of technical, scientific, and management advances related to the management of federal contaminated sites. For further information, contact Andrea Peters at 613-952-5374 or Peters.Andrea@tbs-sct.gc.ca.

Dr. Richard Playle

We regret to announce the untimely passing of **Dr. Richard Playle**, faculty member at Wilfrid Laurier University. **Dr. Playle** was principal investigator of the A2 project under our Aquatic Ecosystem Theme Team.

Welcome Dr. Michael Wilkie

We welcome a new researcher to the Aquatic Ecosystem Theme. **Dr. Michael Wilkie**, Professor, Biology Dept., Wilfrid Laurier University, will supervise project A2, formerly overseen by the late **Dr. Playle**.

2005 SETAC / Chris Lee Award for Metals Research

Lisa Kraemer, a PhD student at INRS Eau Terre et Environnement co-supervised by **Peter Campbell** and **Landis Hare**, has been awarded the 2005 SETAC / Chris Lee Award for Metals Research. Lisa's PhD research, funded by the earlier MITE Research Network, focused on the dynamics of metal uptake, storage and elimination in juvenile yellow perch (*Perca flavescens*), a fish species that is found naturally in metal-impacted environments. Rather than carry out laboratory experiments, Lisa chose to work in the field, a choice that increased the environmental realism of her studies, but one that also proved experimentally challenging (ironically, yellow perch are known as a metal-tolerant fish species, but they proved more difficult to manipulate in the field than originally anticipated). The award, sponsored by the International Copper Association, was initiated by SETAC to recognize the leadership and technical contributions of the late Dr. Chris Lee. Appropriately, Dr. Lee was one of the first industrial representatives to express his support for the original MITE-RN initiative. The award provides up to $5,000 to a graduate student or recent graduate who has focused on research related to the fate and/or effects of metals in the environment. ¶

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soil, and food are the principal routes of exposure of humans to metals; consequently, there is a need to quantify and characterize metals present in these matrices with specific reference to their speciation and bioavailability. The science plan also recognizes that the ecological health of aquatic and terrestrial ecosystems is a critical component of human community health.

The research program, comprised of three themes (Aquatic Ecosystem; Soils and Plants; and Foods and Ingested Particles) represents a cascade of effects along food webs, from the lowest trophic levels to the highest consumers. For each of the themes, the same three questions drive the research projects:

- Distinguishing the magnitudes and roles of natural background and anthropogenic metal inputs in biotic exposure to metals.
- Estimating the bioavailable fraction of metals in the exposure media, thus better quantifying the true exposure concentration.
- Determining the factors that influence bioavailability of metals in media, so that predictive models can be developed for use in the development of site-specific metals criteria.

Research to address these three questions will vary according to the media and endpoints of importance to each theme, and the specific hypotheses to be tested. As well, the specific metals to be studied in each project will be similarly tailored to the project; metals and metalloids of prime interest include: Cd, Cu, Pb, Ni, Tl, U, Zn, As and Se.

The 16 research projects conducted in the first three years of the Network program promote collaborations among academic researchers in 21 Canadian universities and with many government scientists.

A team of three risk assessment consultants [see E &HHRA page 5 of newsletter] ensure that the MITHE-RN research projects, in all three themes, address the risk assessment priorities of all Network partners. ❡

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