



International Symposium on the Health Hazard  
Evaluation of Fibrous Particles Associated with  
Taconite and the Adjacent Duluth Complex

**Organized by the:**

International Environmental Research Foundation  
New York, New York

Environmental Sciences Laboratory  
Brooklyn College of The City University of New York  
Brooklyn, New York

Minnesota Department of Health  
St. Paul, Minnesota

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*St. Paul, Minnesota ■ ■ ■ Dates: March 30 - April 1, 2003*

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## **Acknowledgements**

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Mr. Ernest Lehmann, President, MExA

Mr. Frank Ongaro, President, Iron Mining Association

## **Mission Statement**

This International Symposium will be convened to assess the current state of knowledge concerning any health hazards, which might be associated with the ingestion and inhalation of fibrous particles produced from the processing of taconite ore.

Concern about fibrous particles in taconite arose from their similarities to fibers of amphibole asbestos minerals, which are known to be human carcinogens. The mineralogical characteristics of asbestos fibers will be reviewed and compared with the fibrous particles known to be present in taconite ore from the eastern end of the Iron Range. The epidemiological and experimental animal studies for asbestos-related disease (including gastrointestinal cancer from asbestos in drinking water) will be evaluated and compared to those of the fibrous minerals in the taconite. The focus will be on the amphiboles in the cummingtonite-grunerite and tremolite-ferroactinolite series and other fibrous particles in both the Iron Range and Duluth Complex. This will include examination of the reported occurrences of any asbestiform ferroactinolite, crocidolite asbestos, chrysotile asbestos, etc. In addition, an effort will be made to provide a scientific framework to address fibrous minerals which may be associated with non-ferrous mineral deposits in the rock of the Duluth Complex.

State-of-the-art risk assessment models for asbestos will be presented for developing worst-case and reasonably realistic scenarios for the fibrous particles associated with taconite and possibly the Duluth Complex. Risk assessment scenarios will be developed for environmental exposure levels related to the operation of the Silver Bay taconite processing facility and the use of taconite as aggregate. After a review and analysis of the information presented at the Symposium the Minnesota Department of Health intends to conduct a Risk Assessment for exposure to the types of fibrous particles found in taconite and possibly the Duluth Complex.

## Purpose of International Symposium

Minnesotans have been interested in the issue of mineral fibers in taconite ore – particularly from the eastern end of the Iron Range – since the Reserve Mining Case in the 1970s highlighted the presence of “asbestiform minerals” in that ore body. Since then, numerous studies have been conducted on the ore, as well as people who work in the mining industry; however, due to a number of reasons including study limitations and lack of current scientific data, many significant questions remain unanswered.

The Blue Ribbon Committee on Mining, an interdisciplinary group convened by the State of Minnesota and the Office of Congressman James Oberstar, and the state’s Minerals Coordinating Committee each have identified the lack of up-to-date scientific research to help address unanswered questions as a stumbling block to further development of minerals from the eastern end of the Iron Range, including taconite, non-ferrous minerals and waste rock from taconite processing, which can be used as aggregate. In 2001, the Blue Ribbon Committee formed a task force to plan a symposium to help address these issues.

Meanwhile, two related events occurred that further have increased Minnesotan’s interest in mineral fibers. First, reports in 2001 that a vermiculite mine in Libby, Montana, might have been contaminated with asbestos led the Minnesota Department of Health (MDH) to study the health risks of residents in Northeast Minneapolis who might have been exposed to vermiculite-containing asbestos that was processed at a nearby insulation plant. Second, in March 2003 the MDH released a multi-year study on Minnesota iron miners who contracted mesothelioma – a rare form of cancer linked to exposure to asbestos. The study concluded that exposure to commercial asbestos in the workplace – not necessarily taconite ore – was the likely cause of the reported mesothelioma cases.

The *International Symposium on the Health Hazard Evaluation of Fibrous Particles Associated with Taconite and the Adjacent Duluth Complex* will convene international experts in the field of fibers and their associated health risks to present state-of-the-art, up-to-date research findings and to engage in panel discussions on those findings. The goals are to provide current information on risk-assessment models and scenarios on health hazards associated with inhaling or ingesting fibrous particles – particularly those produced from the processing of taconite ore; to establish a scientific framework to address fibrous minerals that may be associated with non-ferrous mineral deposits and to establish a scientific basis for public policy decisions based on the current state of scientific knowledge.

Papers presented at the symposium will undergo a thorough peer-review process before being compiled – along with an edited version of panel discussion – in a monograph that will be provided to state agencies in the first quarter of 2004. Agencies will be able to use this scientific data as one source of information gathered during their public decision-making processes for permits, health risk assessments, clean-up levels, etc.

## Questions to be Addressed by the Scientific Program of the Symposium

1. The concern about the microscopic fibrous particles in taconite originated from what observations? Are they still valid? What do we actually know about the health hazards of the fibrous particles including cleavage fragments that might result from processing taconite?
2. What are the physico-chemical properties of the fibrous particles in taconite ore, including crocidolite asbestos and asbestiform ferroactinolite, which indicate a potential for health hazard?
3. How do typical concentrations of airborne and waterborne fibrous particles – determined by state-of-the-art analytical transmission electron microscopy methods – found in the area surrounding the taconite processing plant in Silver Bay compare with background levels reported for asbestos around the world? What do we know about the importance of fiber length – is there any new evidence regarding the length of fibers and toxicity? What are the data required for determining if taconite waste rock and coarse tailings from the eastern end of the Iron Range can be used off-site? What considerations about fibrous minerals, if any, should be given in the development of non-ferrous mineral deposits in the Duluth Complex rocks?
4. What do the experimental animal studies reveal about the differences between the inhalation/injection/ingestion of asbestos and other fibrous mineral particles?
5. Do studies in human populations tell us anything about the potential health hazards, which might occur from exposure to fibers similar to those found in taconite?
6. What are the views held by the various Federal Regulatory Agencies (OSHA/EPA/MSHA/CPSC) regarding the distinction between asbestos and the fibrous particles associated with taconite? What is the importance of asbestos fiber type (mineral species), morphology, biopersistence and surface properties?
7. Using available risk assessment models for asbestos exposure, what are the lung cancer and mesothelioma risks associated with the environmental taconite exposures? What can be said about non-cancer risk of asbestos-related disease?
8. What is the scientific evidence that bears on the question that amphibole-bearing taconite from the eastern most end of the Biwabik Iron Formation, if used as aggregate, would pose a public health concern different from other widely used aggregate sources? How would one go about doing a risk assessment for the use of taconite waste rock as aggregate? Is there sufficient information available to perform a risk assessment for the use of this taconite waste rock as aggregate?
9. What science, if any, has developed since 1976, which might have influenced the Reserve Mining decision? Is it consistent with the scientific information available earlier or does it suggest some changes should be made?
10. Will new taconite production processes such as the direct reduced iron process (DRI) have any effect on the ambient fiber levels in Silver Bay?



## **Publication of the Workshop**

The twenty-four papers will be prepared prior to or soon after the Symposium. After the presentations, the papers will be sent out for peer review before publication. The speakers will be required to submit their papers prior to the Symposium to allow the monograph to be published in a timely manner.

We are proposing to include edited accounts of the Panel Discussions, Questions Period, six Rapporteur's reports (one summarizing each Session) and an Introduction and Summary for the Symposium. The details of the Symposium's published form will be reviewed by the Scientific Committee when the program is finalized.

## **Program**

*Three-Day International Symposium on  
The Health Hazard Evaluation of Fibrous Particles Associated  
with Taconite and Adjacent Duluth Complex*

**Saturday, March 29, 2003**

### **Cocktail Reception**

7:30 PM – 10:00 PM

L'Etoile Room

### **The Saint Paul Hotel**

350 Market Street  
St. Paul, Minnesota 55102  
(651) 292-9292

**Sunday, March 30, 2003**

**Session I: Origin of the Problem**

**Chair:** *Prof. Arthur M. Langer*

**Rapporteur:** *Malcolm Ross*

The Saint Paul Hotel  
St. Paul, Minnesota

**MORNING SESSION**

**EVENT LOCATION**

7:30 AM – 8:30 AM	<b>Buffet Breakfast</b>	Casino South
7:30 AM – 8:30 AM	<b>Registration Desk</b>	Archbishop Ireland
9:15 AM – 9:30 AM	<b>Welcome</b> <i>Ann Glumac, International Environmental Research Foundation</i> <i>Tom Reagan, Co-Chair, Minnesota Blue Ribbon Committee on Mining</i>	Casino North
9:30 AM – 10:00 AM	<b>Paper 1 – Geology of the Biwabik Iron Formation and Duluth Complex.</b> <i>James D. Miller, Jr. and Mark A. Jirsa</i>	Casino North
10:00 AM – 10:30 AM	<b>Paper 2 – Overview of the Mineralogy of the Mesabi Iron Range and the Duluth Complex.</b> <i>Peter L. McSwiggen and G.B. Morey</i>	Casino North
10:30 AM – 10:45 AM	<b>Coffee Break</b>	Casino North
10:45 AM – 11:15 AM	<b>Paper 3 – Definitions of Asbestos Minerals.</b> <i>R.P. Nolan and Malcolm Ross</i>	Casino North
11:15 AM – 11:45 AM	<b>Paper 4 – Reserve Mining and the Asbestos Case.</b> <i>William Brice and Michael Berndt</i>	Casino North
11:45 AM – 12:15 AM	<b>Panel Discussion</b>	Casino North
12:15 AM – 1:30 PM	<b>Buffet Lunch</b>	Casino South

Sunday, March 30, 2003

**Session II: Characterization of Fibrous Minerals**

**Chair:** *Richard J. Lee*

**Rapporteur:** *Prof. Arthur M. Langer*

The Saint Paul Hotel  
St. Paul, Minnesota

**AFTERNOON SESSION**

		<b><u>EVENT LOCATION</u></b>
1:30 PM – 2:00 PM	<b>Paper 1 – The Search for Fibrous Minerals within the Peter Mitchell Taconite Mine, Babbitt, Minnesota.</b> <i>Malcolm Ross, R.P. Nolan and Gordon L. Nord</i>	Casino North
2:00 PM – 2:20 PM	<b>Paper 2 – Characterization of Fibrous Particles by Analytical Transmission Electron Microscopy.</b> <i>Gordon L. Nord and Richard J. Lee</i>	Casino North
2:20 PM – 2:40 PM	<b>Paper 3 – Analysis of Airborne and Waterborne Particles Around a Taconite Ore Processing Facility.</b> <i>Charles W. Axten and David Foster</i>	Casino North
2:40 PM – 3:10 PM	<b>Questions</b>	Casino North
3:10 PM – 3:30 PM	<b>Coffee Break</b>	Casino North

Sunday, March 30, 2003

**Session III: Exposure to Grunerite (Amosite) Asbestos:  
Historical Perspectives of the Health Effects**

**Chair:** *Jeffrey L. Myers*  
**Rapporteur:** *Graham Gibbs*

The Saint Paul Hotel  
St. Paul, Minnesota

**AFTERNOON SESSION**

		<u>EVENT LOCATION</u>
3:30 PM – 4:00 PM	<b>Paper 1 – Health Effects of Amosite Mining and Milling in South Africa.</b> <i>Jill Murray</i>	Casino North
4:00 PM – 4:30 PM	<b>Paper 2 – Human Health Effects Associated with the Commercial Use of Grunerite (Amosite) Asbestos: Paterson, NJ – Uxbridge, United Kingdom.</b> <i>Joseph Ribak</i>	Casino North
4:30 PM – 5:00 PM	<b>Paper 3 – Asbestos-Related Disease at Conwed, Cloquet, MN</b> <i>Alan P. Bender and Allan N. Williams</i>	Casino North
5:00 PM – 5:30 PM	<b>Panel Discussion</b>	Casino North
6:00 PM – 7:00 PM	<b>Cocktail Hour</b>	Casino South
7:00 PM – 9:00 PM	<b>Buffet Dinner</b>	Casino South

Monday, March 31, 2003

**Session IV: Grunerite (Amosite) Asbestos and Tremolite-Ferroactinolite Asbestos:  
Risk of Environmental Mesothelioma**

**Chair:** *Joseph Ribak*

**Rapporteur:** *Geoffrey Berry and John F. Gamble*

The Saint Paul Hotel  
St. Paul, Minnesota

**MORNING SESSION**

		<b><u>EVENT LOCATION</u></b>
7:30 AM – 8:30 AM	<b>Buffet Breakfast</b>	Casino South
9:00 AM – 9:20 AM	<b>Paper 1 – South African Experience with Asbestos-Related Environmental Mesothelioma: Is Asbestos Fiber Type Important?</b>  <i>Gillian Nelson</i>	Casino North
9:20 AM – 9:50 AM	<b>Paper 2 – Asbestos Exposure and Health Risks: Libby, Montana.</b>  <i>Bertram Price</i>	Casino North
9:50 AM – 10:20 AM	<b>Paper 3 – Environmental Mesothelioma Associated with Fibrous Tremolite: Lessons from The Experience in Turkey, Greece, Corsica, New Caledonia and Cyprus.</b>  <i>Stavros H. Constantopoulos</i> <i>(to be presented by Joseph Ribak)</i>	Casino North
10:20 AM – 10:40 AM	<b>Coffee Break</b>	Casino North
10:40 AM – 11:00 AM	<b>Paper 4 – Non-Occupational Exposure Issues: Libby, Montana.</b>  <i>Christopher P. Weis and Aubrey K. Miller</i>	Casino North
11:00 AM – 11:20 AM	<b>Paper 5 – Evidence for Occupational &amp; Environmental Exposure to Asbestos from a Vermiculite Exfoliation Plant in NE Minneapolis.</b>  <i>James Kelly, J. Johnson, L. Souther, D. Durkin, Tannie Eshenauer, Rita Messing and G. Pratt</i>	Casino North
11:20 AM – 11:45 AM	<b>Paper 6 – Investigation of Exposures to Commercial Asbestos in Northeastern Minnesota Iron Miners who Developed Mesothelioma.</b>  <i>Wendy Brunner, Allan N. Williams, and Alan P. Bender</i>	Casino North
11:45 AM – 12:00 PM	<b>Panel Discussion</b>	Casino North
12:00 PM – 1:15 PM	<b>Buffet Lunch</b>	Casino South

Monday, March 31, 2003

**Session V: Experimental Animal and Epidemiology Studies of Asbestos  
and Non-Asbestos Tremolite Including Ingestion Studies**

**Chair:** *Charles W. Axten*  
**Rapporteur:** *Malcolm Ross*

The Saint Paul Hotel  
St. Paul, Minnesota

**AFTERNOON SESSION**

		<b><u>EVENT LOCATION</u></b>
1:15 PM – 1:45 PM	<b>Paper 1 – Experimental Studies of Asbestos and Non-Asbestos Tremolite.</b> <i>John Addison and Kenneth Donaldson</i>	Casino North
1:45 PM – 2:15 PM	<b>Paper 2 – Relative Potencies of Mineral Fibers <i>in vivo</i>: Ferroactinolite from Taconite.</b> <i>Philip M. Cook, Lalita D. Palikar and David E. Coffin</i>	Casino North
2:15 PM – 2:45 PM	<b>Paper 3 – Mechanisms of Fiber Carcinogens.</b> <i>Agnes B. Kane</i>	Casino North
2:45 PM – 3:15 PM	<b>Paper 4 – Ingestion Studies of Asbestos and Non-Asbestos Particles in Experimental Animals to Evaluate Carcinogenic Potential.</b> <i>Ernest E. McConnell</i>	Casino North
3:15 PM – 3:45 PM	<b>Paper 5 – Risk of Gastrointestinal Cancer from Inhalation and Ingestion of Amphibole Asbestos.</b> <i>John F. Gamble</i>	Casino North
3:45 PM – 4:00 PM	<b>Coffee Break</b>	Casino North
4:00 PM – 4:45 PM	<b>Panel Discussion</b>	Casino North
<b>AFTERNOON BREAK</b>		
7:00 PM – 8:00 PM	<b>Cocktail Hour</b>	James J. Hill
8:00 PM – 10:00 PM	<b>Dinner</b> <i>Featured Speaker: Robert V. Bartlett, Purdue University</i>	James J. Hill

**Tuesday, April 1, 2003**

**Session VI: Risk Assessment of Asbestos and Fibrous Mineral Particulates**

**Chair:** *A.M. Langer and Geoffrey Berry*

**Rapporteur:** *R.P. Nolan*

The Saint Paul Hotel  
St. Paul, Minnesota

**MORNING SESSION**

		<b><u>EVENT LOCATION</u></b>
7:30 AM – 8:30 AM	<b><i>Continental Breakfast</i></b>	Casino South
8:30 AM – 9:00 AM	<b>Paper 1 – Control and Monitoring of Asbestos in the United States – Regulatory Overview of Asbestos and Other Fibrous Minerals.</b> <i>Prof. A.M. Langer</i>	Casino North
9:00 AM – 9:45 AM	<b>Paper 2 – State-of-the-Art Asbestos Risk Assessment: An Up-Date to 2002.</b> <i>Geoffrey Berry and Graham Gibbs</i>	Casino North
9:45 AM – 10:40 AM	<b><i>Rapporteur's Reports</i></b>	Casino North
10:40 AM – 11:00 AM	<b><i>Coffee Break</i></b>	Casino North
11:00 AM – 11:45 AM	<b><i>Rapporteur's Reports</i></b>	Casino North
11:45 AM – 12:35 PM	<b>Paper 3 – Risk Assessment from Human Exposure to Fibrous Particulates in Taconite Ore Due to Environmental Exposures and Those Associated with the Use of Aggregate Waste Rock.</b> <i>Prof. Richard Wilson, R.P. Nolan and Charles W. Axten</i>	Casino North
12:35 PM – 1:35 PM	<b><i>Panel Discussion</i></b>	Casino North
1:45 PM – 2:45 PM	<b><i>Buffet Lunch</i></b>	Casino South