



"The rocks are the final court of appeal" Francis Pettijohn

# Precambrian Research Center

## Minnesota's Iron & Cu-Ni-PGE Resources: A Workshop for Investors

April 23-25, 2008  
Duluth, Minnesota

For Registration Form and other Workshop Information visit:  
[http://www.d.umn.edu/prc/workshops/08\\_Inv\\_Workshop.html](http://www.d.umn.edu/prc/workshops/08_Inv_Workshop.html)



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### Introduction

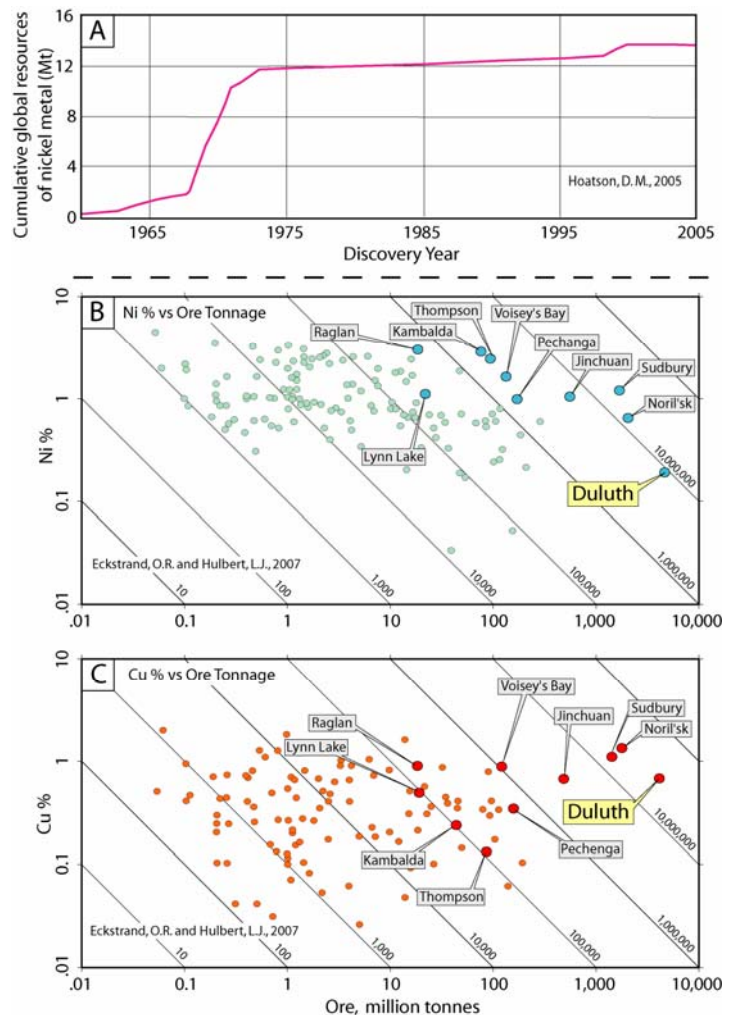
Since the early 1870s, the University of Minnesota has played the preeminent role in **describing** the State of Minnesota's mineral resources. As well, state-sponsored university research programs have played a key role in **development** of these resources (for example, the process to economically mine low-grade taconite ores from the Mesaba Iron Range was developed by University of Minnesota professor Edward W. Davis, in the early 1950s). More recently, the university, in coordination with the state legislature and the Department of Natural Resources, has concentrated much effort in **documenting** the vast resources of copper-nickel-platinum group element (Cu-Ni-PGE) mineralization in the Duluth Complex of northeastern, Minnesota. The University of Minnesota Duluth's (UMD) Natural Resources Research Institute's (NRRI) mission is to foster economic development of Minnesota's natural resources in an environmentally sound manner to promote private sector employment. NRRI's efforts cover an array of activities which focus on collaboration with the public sector and private industry.

### Importance of Duluth Complex Mineralization

Magmatic Ni-Cu-PGE deposits provide most of the Ni produced in the world and essentially all of the world's Platinum Group Elements. Relative to other deposit types, Ni-Cu-PGE deposits are rare, in total there are only 142 such deposits in the world that contain more than 100,000 tonnes of resources and/or production. As well, the discovery rate for this important class of ore deposit has remained flat since the mid 1970s (Fig. 1a).

World demand and consumption of copper, nickel and platinum-group metals continue to rise both in developed countries and developing nations (lead by China). World production of copper exceeded 15 million tons in 2006 and nickel production reached an all time high of 1.55 million tons. The need for these metals is projected to increase as development in China and India continues, and many African developing countries attempt to follow their example.

Many basic attributes of the Duluth Complex Cu-Ni-PGE sulfide deposits resemble those of the giant deposits at Noril'sk, Russia, Jinchuan, China, and Voisey's Bay, Canada. Such attributes include shallow tholeiitic intrusions associated with plateau basalt volcanism,



**Figure 1.** Global resources of Ni metal (A), and tonnage and grades of Ni (B) and Cu (C) for magmatic Ni-Cu sulfide deposits. Inclined contours show quantities of contained metals (tonnes) in insets B and C.

external sedimentary sources of sulfur, and openness to repeated magma influx and expulsion. The importance of the Duluth Complex Cu-Ni-PGE resource in the global view of this class of deposits is best exemplified in the grade-tonnage diagrams presented in Figure 1b and 1c, where only the great deposits of the Sudbury and Noril'sk camps rival the Duluth Complex in contained Cu and Ni. Based on USGS 2005 Mineral Commodity Reports, which do not conform to NI43-101 standards, the Duluth Complex contains ~95% of the U.S. Ni resources, ~34% of the U.S. Cu resources, and ~75% of the U.S. PGE resources.

### Importance and Developments in Minnesota's Iron Mining Industry

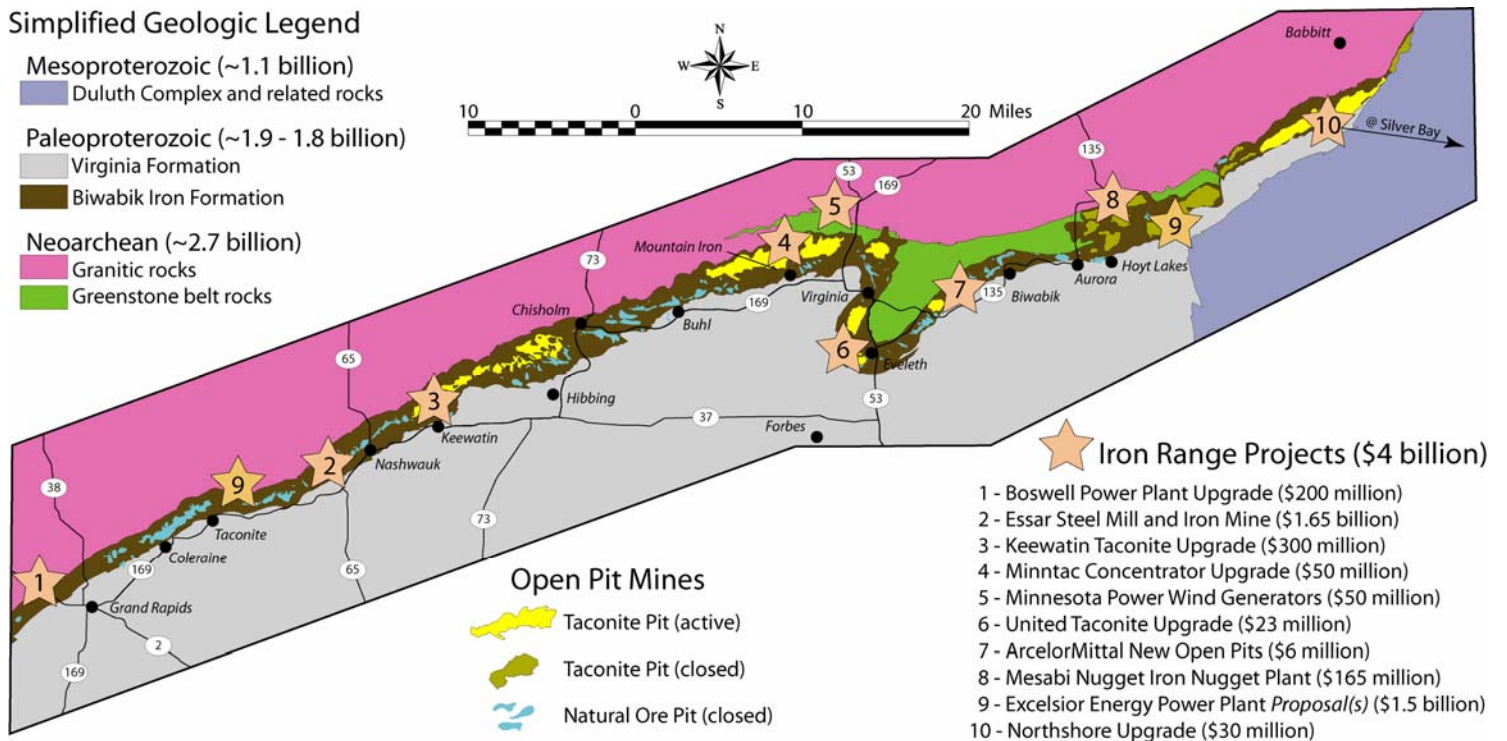
Minnesota's iron mining industry produces approximately 70% of the ore utilized in the US steel industry. At the current production rate of approximately 40 million tons of taconite pellets annually, established resources of iron ore from Minnesota's Mesabi Iron Range (27 billion tons) could sustain production for >200 years. Many major developments have recently been initiated along the 120 mile corridor in Minnesota's iron mining industry. U.S. Steel modernized a pelletizing line at its flagship Minntac mine and will invest \$300 million in Keewatin Taconite, increasing pellet production there from six million to nearly ten million tons per year. Cleveland-Cliffs has upgraded the United Taconite facilities and restarted an idled pelletizing line at the Silver Bay processing plant, adding 800,000 tons to its annual capacity at the Northshore Mine. ArcelorMittal's opening of two new open pit mines (East pits #1 and #2) near McKinley will ensure the Minorca mining complex an additional 15 years of operation. Steel Dynamics Inc. and Kobe Steel Ltd. have formed a new corporation, Mesabi Nugget Delaware LLC to construct and operate an iron nugget manufacturing plant on the eastern range at a cost of \$165 million. Construction has begun and the plant is expected to have an annual capacity of 500,000 metric tons and to begin iron nugget production in mid-2009. Essar Steel plans to build a \$1.65 billion complex on the west range that would integrate mining, processing and steel production on one site, and would produce 2.5 million tons of unfinished steel slabs a year.

Electrical power generation along the Mesabi Iron Range has also seen major recent developments. Minnesota Power is upgrading its Boswell power plant on the west range and is constructing a wind generating facility in the central range. Excelsior Energy has proposed to build a \$1.5 billion coal gasification power plant at one of two locations on the west and east range. A location map of all of these Mesabi Iron Range projects is presented in Figure 2.

Northeast Minnesota's U.S. Congressman James Oberstar has a long history in keeping Minnesota's taconite industry competitive throughout his service in Congress. Oberstar recently introduced the Water Resources Development Act (WRDA) which was enacted into law last year. WRDA includes provisions to dredge long-neglected harbors and shipping channels across the Great Lakes. As well, the WRDA authorizes \$341 million to construct a second lock to accommodate modern ships at Sault Ste. Marie, and another \$134 million is authorized to make other repairs and upgrades on the St. Lawrence Seaway.

### Simplified Geologic Legend

- Mesoproterozoic (~1.1 billion)
  - Duluth Complex and related rocks
- Paleoproterozoic (~1.9 - 1.8 billion)
  - Virginia Formation
  - Biwabik Iron Formation
- Neoproterozoic (~2.7 billion)
  - Granitic rocks
  - Greenstone belt rocks



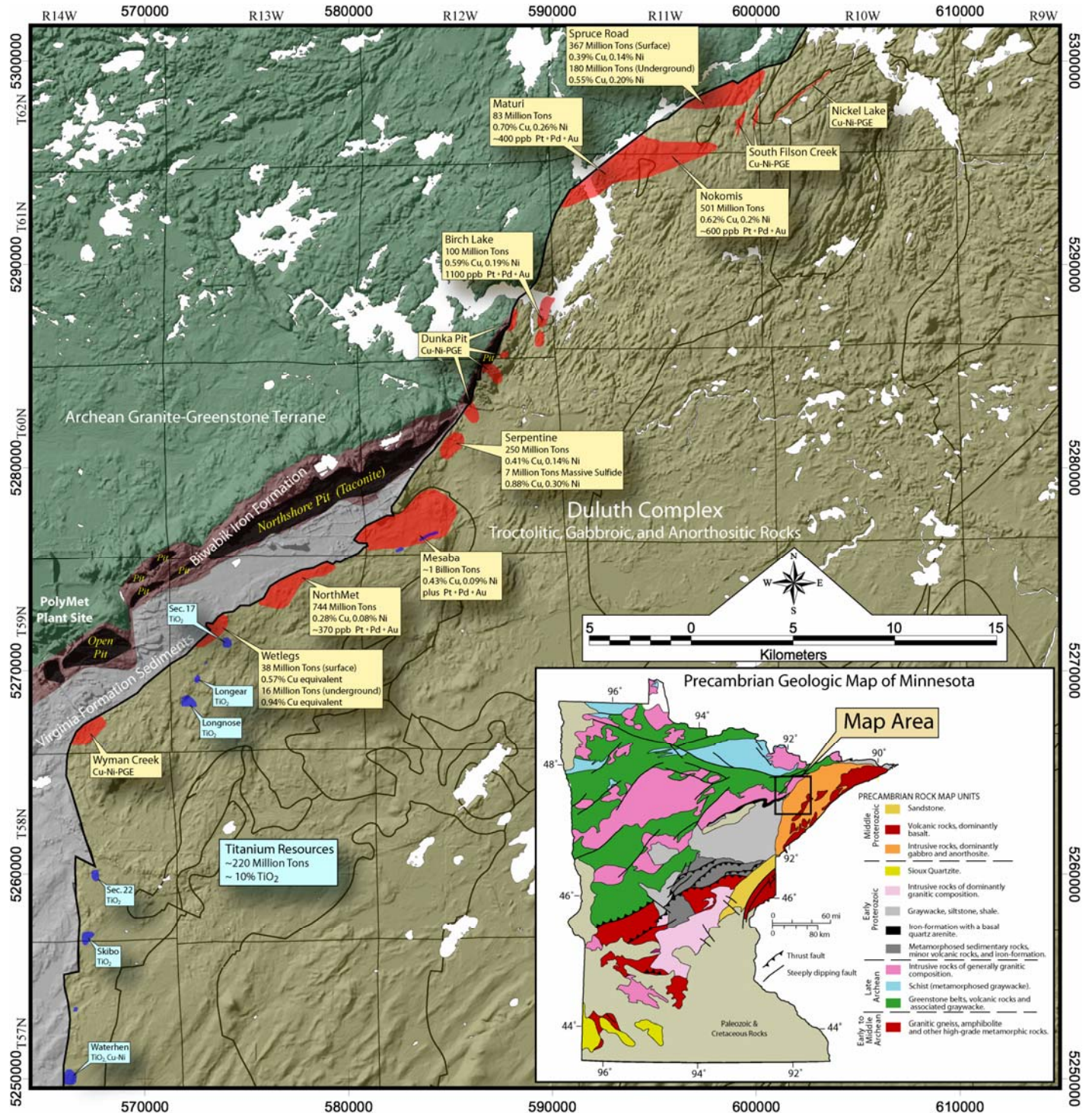
**Figure 2.** Large iron ore and electrical generation projects along the Mesabi Iron Range.

### About the Workshop

The workshop is designed to **educate** the investment community on Minnesota's vast Duluth Complex Cu-Ni-PGE resources as well as on new developments in Minnesota's iron mining industry. The Cu-Ni-PGE resources (Fig. 3) are currently being actively explored and/or are in the process of permitting by PolyMet Mining (NorthMet deposit), Teck-Cominco (Mesaba deposit), Franconia Minerals

(Birch Lake, Maturi and Spruce Road deposits), Duluth Metals Limited (Nokomis deposit), and Encampment Resources (South Filson Creek Prospect). The value, at today's metal prices, of the published resource estimates for these deposits (see Fig. 3) exceeds \$258 billion dollars. The workshop will lead off with a day and a half of presentations and will conclude with optional field trips to the Department of Natural Resources drill core facility at Hibbing and a tour of the extensive mining along the Mesaba Iron Range. Opportunities to visit field offices of the active exploration programs will be arranged through the companies as part of the field excursion. Participants of the workshop can expect to gain:

- 1) Knowledge of the Duluth Complex Cu-Ni-PGE ores and their hydrometallurgical processing
- 2) Understanding of the state of iron mining in Minnesota's Mesabi Iron Range
- 3) Realization of the commitment of the State of Minnesota to see that natural resources are developed in an environmentally sound manner for the economic betterment of its citizens as well as the country.



**Figure 3.** Simplified terrain and geological map of the northwestern Duluth Complex and adjacent rock units. The locations of identified mineral resources within the Duluth Complex are highlighted.

## Workshop

Workshop dates are Wednesday, April 23 – Thursday, April 24, 2008, with an optional overnight (April 24-25) field excursion to Minnesota's Mesaba Iron Range (tour of a Cleveland Cliffs open pit taconite mine and pelletizing plant), the Department of Natural Resource's drill core storage facility, and tours of exploration company field offices. The educational experience provided to the participants on the Minnesota's Iron Range and Duluth Complex Cu-Ni-PGE resources has been divided into four themes:

### **Theme 1: Geology, mineralization, and processing of Duluth Complex Cu-Ni-PGE ores**

Presentations: Ni-Cu-PGE deposits, a worldwide perspective; Geology of the Duluth Complex; Styles of Cu-Ni-PGE mineralization in the Duluth Complex; 3D visualizations and new models on the distribution of Cu-Ni-PGE in the Duluth Complex; and Hydrometallurgical processing potential of Duluth Complex ores.

### **Theme 2: Public infrastructure in support of base-metal mining in Minnesota**

Presentations: Mining in Minnesota and existing infrastructure; Mineral Diversification in Minnesota; Economic impact of Cu-Ni-PGE mining in Minnesota; State and Local Government Perspective on Cu-Ni-PGE Mining; tour of the State of Minnesota drill core repository in Hibbing and views of selected Duluth Complex drill core at the facility

### **Theme 3: Exploration company presentations**

Presentations: Franconia Minerals; Duluth Metals Limited

### **Theme 4: Importance and future of iron mining and related mining infrastructure in northeastern Minnesota**

Presentations: State of Minnesota's mineral diversification program; State and local government perspective on mining; Mining in Minnesota; and a tour of an active taconite mine and processing facility

## Workshop Speakers

- **Dr. Don Fosnacht** – Director, Center for Applied Research and Technology Development; NRRI
- **Dr. Jon Scoates** – Manitoba Geological Survey and the Geological Survey of Canada, retired
- **Dr. Jim Miller** – Associate Professor, UMD Geological Sciences; University of Minnesota Duluth
- **Mr. Mark Severson** - Research Fellow, NRRI; University of Minnesota Duluth
- **Dr. Dean Peterson** – Senior Research Associate, NRRI; University of Minnesota Duluth
- **Mr. Daniel Colton** – Attorney at Law; Leonard, Street and Deinard
- **Mr. Peter Clevenstine** – Manager of Engineering and Mineral Development; Minnesota Department of Natural Resources
- **Dr. Cesar J. (Joe) Ferron** – President, HydroProc Consultants (Key member, Platsol Process development)
- **Mr. Ronald Graber** – Cleveland Cliffs
- **Mr. Frank Ongaro** – Executive Director, Mining Minnesota
- **Mr. Marty Vadis** – Director, Lands and Minerals Division; Minnesota Department of Natural Resources
- **Ms. Sandy Layman** – Commissioner, Iron Range Resources; Minnesota State Government
- **Exploration Company Representatives**
  - **Mr. Brian Gavin** – President & CEO, Franconia Minerals
  - **Dr. Henry (Rick) Sandri** – President & CEO, Duluth Metals Limited

## Registration and Fees

### **Early Bird** (postmarked on or before April 7)

\$500 - Workshop-only Fee

\$650 - Workshop and Field Trip Fee

### **Late Registration** (postmarked after April 7)

\$700 - Workshop-only Fee

\$850 - Workshop and Field Trip Fee

Payable by check or money order made out to: **University of Minnesota Duluth**

Registration materials available at the PRC website: [http://www.d.umn.edu/prc/workshops/08\\_Inv\\_Workshop.html](http://www.d.umn.edu/prc/workshops/08_Inv_Workshop.html)

### The workshop-only fee includes:

- Copy of workshop program with abstracts
- Copy of PowerPoint presentations on CD
- Banquet dinner Wednesday evening (4/23) at the Inn on Lake Superior
- Afternoon and morning coffee breaks during workshop

The workshop and field trip fee includes the above, plus:

- Copy of field excursion guide
- Field trip transportation by coach bus
- Lodging (double occupancy) at the Hibbing Park Motel
- Dinner on Thursday evening (4/24) at Jimmy's Bar and Grill in Hibbing
- Lunches and refreshments during field excursion (4/24 – 4/25)

Visit the Investor Workshop webpage for information about **transportation and lodging** during the workshop [http://www.d.umn.edu/prc/workshops/08\\_Inv\\_Workshop](http://www.d.umn.edu/prc/workshops/08_Inv_Workshop)

### **Tentative Workshop Schedule**

**Wednesday, April 23** – Geology, Mineralization, and Processing of Duluth Complex Cu-Ni-PGE Ores

**Location:** Eagle Harbor room, Inn on Lake Superior

12:30 PM	Don Fosnacht	Opening remarks
12:40 PM	Jon Scoates	Worldwide Ni-Cu-PGE deposits
1:15 PM	Jim Miller	Geology of the Duluth Complex
1:45 PM	Mark Severson	Styles of mineralization (Cu-Ni-PGE; TiO <sub>2</sub> ) in the Duluth Complex
2:15 PM	Dean Peterson	New ideas and 3D visualizations of the Duluth Complex
2:45 PM		Coffee break and drill core displays
3:30 PM	Joe Ferron	Hydrometallurgical processing of Duluth Complex ores
4:15 PM	Peter Clevensine	Providing Sustainable Iron Ore to the North American Steel Industry
5:00 PM		Social hour (sponsored)
6:00 PM		Banquet Dinner
8:00 PM	Ron Graber	TBA

**Thursday, April 24** – The Mining Business in Minnesota; Exploration Co. Presentations

**Location:** Eagle Harbor room, Inn on Lake Superior

8:00 AM	Frank Ongaro	Mining in Minnesota
8:45 AM	Marty Vadis	State of Minnesota's mineral diversification program
9:15 AM	Sandy Layman	State and local government perspective on mining
9:45 AM		Coffee break; Drill Core Displays: Cu-Ni-PGE mineralization
10:30 AM	Daniel Colton	Financing mineral opportunities under Minnesota's regulatory conditions
11:00 AM	Brian Gavin	Franconia Minerals
11:30 AM	Rick Sandri	Duluth Metals Limited
12:00 PM		<i>End of Workshop</i>

### **Optional Workshop Field Excursion**

**Thursday, April 24** – Open Pit Mine and Processing Plant Tour on the Mesabi Iron Range

12:45 PM		Pick up box lunch, transfer luggage to coach bus
1:00 PM		Field excursion to Cleveland Cliff's United Taconite mine and the Forbes pelletizing plant
5:30 PM		Check in, Hibbing Park Hotel ( <a href="#">website</a> )
6:30 PM		Social hour
7:30 PM		Buffet Dinner, Jimmy's Bar & Grill ( <a href="#">website</a> ) and soak up a little Bob Dylan atmosphere

**Friday, April 25** – DNR Drill Core Library, Hibbing; Exploration Company Offices, Ely & Hoyt Lakes

8:00 AM	Mark Severson	DNR drill core facility, Duluth Complex mineralization drill core display
9:30 AM		Tour to exploration company field offices, company presentations
12:00 PM		Box lunch on the road
2:00 PM		Return to Duluth with stop at the Duluth International Airport

## **About the Precambrian Research Center**

The Precambrian Research Center is a result of an identified and urgent, long-term need within the private and public sectors of the geological community, both regionally and internationally, for geoscientists skilled in geological mapping and the study of Precambrian geology. The Precambrian Canadian Shield encompasses the northeastern part of North America, primarily in Canada, in addition to much of Minnesota, Wisconsin, and the Upper Peninsula of Michigan in the United States. Such shields of ancient rocks form the cores of all of the continents, and are extremely important to global society because they host a large percentage of the world's resources.

The PRC's mission is to train geoscientists in modern methods of geological mapping of Precambrian rocks and engage students towards geoscience careers that place a strong emphasis on field geology. An intimate appreciation of the power and fundamental nature of field geology gives geologists an appreciation of coherent and compelling field-based scientific arguments upon which all geoscience revolutions are born. The PRC concept evolved as a result of collaboration between three geoscience institutions within the University of Minnesota system: the Economic Geology Group of the NRRI, the Minnesota Geological Survey (MGS), and UMD's Department of Geological Sciences. The PRC will accomplish its goal through five basic program components:

1. *Six week Precambrian geology field camp in northeastern Minnesota*
2. *Graduate assistantships and grants*
3. *Short courses/workshops/field trips*
4. *Upper level geology courses at UMD*
5. *Additional education, outreach, mentoring, and student career planning activities*

All proceeds generated from this workshop will be deposited into the PRC Foundation account held by the College of Science and Engineering at the UMD. Funds from the PRC Foundation are used exclusively to support PRC educational programs that directly benefit students.

## **General Disclaimer**

Entities within the University of Minnesota (UMN) system (specifically the NRRI, PRC, and MGS) have taken all reasonable care in assuring the quality and accuracy of the material to be presented during this conference. The material may however still contain technical or other inaccuracies, omissions, or typographical errors, for which the NRRI assumes no responsibility. The UMN does not warrant or make any representations regarding the use, validity, accuracy, completeness or reliability of any claims, statements or information presented. Under no circumstances, including, but not limited to, negligence, shall the UMN be liable for any direct, indirect, special, incidental, consequential, or other damages.

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## **Forward-Looking Statements**

The material presented may contain forward-looking statements, including but not limited to comments regarding predictions and projections. Forward-looking statements address future events and conditions and therefore involve inherent risks and uncertainties. Actual results may differ materially from those currently anticipated in such statements.

## **Relationship of NRRI to Corporate Entities**

NRRI staff currently collaborates (in the role of technical advisors) with most of the companies exploring for Cu-Ni-PGE in the northeastern Minnesota. As well, the NRRI has developed a strong relationship with Minnesota's taconite producers and continues research along a number of Mesabi Iron Range topics. Such staff are employees of the NRRI and do not receive direct compensation from the companies. Their services are contracted through the NRRI. Many of the companies have also contributed financially to the PRC.

## **For More Information**

Questions about registration or accommodations?

Contact **Jim Miller** – 218.720.4355, [mille066@umn.edu](mailto:mille066@umn.edu)

Questions about the workshop or field excursion?

Contact **Dean Peterson** – 218.720.4393, [dpeters1@nrri.umn.edu](mailto:dpeters1@nrri.umn.edu)

*"The rocks are the final court of appeal" Francis Pettijohn*

*"As the present now, will later be past, the order is rapidly fading. For the times they are a changing." Bob Dylan*

**Registration Form**

(Please fill out one form per registrant)

**PRECAMBRIAN RESEARCH CENTER PROFESSIONAL WORKSHOP SERIES**

***Minnesota's Iron & Cu-Ni-PGE Resources:  
A Workshop for Investors***

***Duluth, Minnesota  
April 23-25, 2008***

Name \_\_\_\_\_

Affiliation \_\_\_\_\_

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Day Phone (\_\_\_\_) \_\_\_\_\_ FAX No. (\_\_\_\_) \_\_\_\_\_

E-Mail \_\_\_\_\_

Indicate Duluth hotel accommodations, if known: \_\_\_\_\_

Indicate any dietary restrictions:  
\_\_\_\_\_

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**\$500** - Workshop-only Fee  
**\$650** - Workshop and Field Trip Fee

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**\$850** - Workshop and Field Trip Fee

Enclose full payment as check or money order payable to: **“University of Minnesota Duluth”**

Mail Registration Form and Payment to:

***PRC Investor's Workshop  
Precambrian Research Center  
Natural Resources Research Institute - UMD  
5013 Miller Trunk Highway  
Duluth, MN 55811 USA***



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