Mission

Mission:
To provide education, training and support in Precambrian field studies for the next generation of geoscientists.

On the cover: Student Gabe Sweet with instructors Dean Peterson and George Hudak at the Classic Soudan Iron Formation outcrop.
The mission of the Precambrian Research Center is to address the new global and local demand for field-trained geoscientists by providing education and support to upper-level undergraduate students, graduate students, and professional geologists in modern methods of geological mapping in Precambrian terrains. The PRC plans to build on the strengths of two geoscience institutions within the University of Minnesota Duluth to accomplish its mission. The Department of Geological Sciences has a long-standing reputation for producing well-trained field geologists specializing in Precambrian geology of the southern Canadian Shield. Additionally, the Natural Resources Research Institute has established strong public-private partnerships with the local minerals industry. The PRC looks to develop a synergistic relationship between these two UMD entities that will create a vehicle for satisfying the urgent demand for field-trained geoscientists. Our programmatic model for the PRC has received very strong support from the geological community in the U.S. and Canada, including executives and geoscientists within the minerals industry, geological surveys, geological societies, and academia.
It all started with conversations in the hallways of our Natural Resources Research Institute (NRRI) offices in the fall of 2005. Phone calls from mineral exploration companies desperately looking to employ well-trained geology students were regularly coming into our offices. We had to admit that few of the students we knew of were adequately trained in field mapping of Precambrian rocks, had any experience at all in drill core logging, or had true understanding of the process of integrating field data into a functional digital database. This led us to generally bemoan the sorry state of geologic mapping in geoscience curricula of U.S. schools and to reflect on the good old days, when the University of Minnesota Duluth (UMD) was well-known for producing field-experienced geology students. Rather than complain about it, we jointly decided to do something about it and the idea for the Precambrian Research Center (PRC) was forged.

Our first task was to determine if an institute devoted to training students in field mapping skills, especially suited to the Precambrian geology of the Canadian Shield, really was needed. After many meetings, emails, and phone calls with our colleagues in academia and industry, the answer was an unequivocal and resounding YES! With this moral support as motivation, our next task was to put our ideas to paper and develop a business plan, which we started in early 2006. Being a couple of field geologists with no business acumen, we relied heavily on our more business savvy colleagues at the NRRI for assistance. After several long months and with a finalized business plan in hand, we approached our superiors within the University of Minnesota to secure their blessing and financial support. Mike Lalich, executive director of the NRRI, and Don Fosnacht, director of NRRI’s Center for Applied Research and Technology Development, could see the potential of such an institute to provide human and informational capital for the burgeoning taconite and nascent base metal industries in the state and agreed to contribute $50,000 in start-up funds for fiscal year 2006. Jim Riehl, Dean of the College of Science and Engineering at UMD, also saw the potential benefit to the University and contributed $25,000 toward the effort.

With these funds, we worked diligently from the summer of 2006 to the spring of 2007 to flesh out the programmatic structure of the PRC, especially the
centerpiece program – the Precambrian field camp slated to begin in the summer of 2007. Planning for the field camp entailed many tasks: organizing and field testing the curriculum, purchasing equipment, digitizing project base maps, recruiting the instructors, planning the logistical support (dorms, food, transportation), developing a website, preparing registration information, promoting the camp to area colleges through school visits and posters, and fundraising to keep the cost of the camp competitive with other U.S. field camps.

As you will read in this report, the inaugural Precambrian field camp involving 15 students was a rousing success that far exceeded our expectations. Bolstered by an increased baseline support from the NRRI of $100,000 for fiscal 2007, we are already preparing for the next year’s camp and are working to get our professional workshop programs off the ground with two events planned for the coming spring.

In this, the first of what we hope are many annual reports to come, we summarize the many successes and a few of the lessons learned in our first year of operation. Since the first kernels of the ideas that grew to be the PRC were planted, we had always envisioned that most of what is to be accomplished by this endeavor should be at minimal cost to the students. The minerals industry stands to be the prime beneficiaries of the PRC programs and the students they produce, and we believe they should be the PRC’s principal benefactors. We are pleased and grateful to those companies and individuals who have provided us support during our first year, without anything more than a promise that we would try our best to accomplish our mission. We hope that those of you in the industry will see the potential that we see in this unique institution and will chose to support the programs of the PRC through corporate and individual memberships and your participation in the professional workshops.

Jim Miller
Dean Peterson
Background: Why a Precambrian field camp?

An Excerpt from the 2006 PRC Business Plan by Dean Peterson and Jim Miller

Geology uses a variety of tools to study the earth. However, the basis for every type of geologic study is fundamentally rooted in observations made of rocks in their natural habitat – in the “field.” An intimate understanding of the fundamentals of field geology gives geologists an appreciation of the coherent and compelling field-based scientific arguments from which all other interpretations grow. All the great concepts in geology that spawned major scientific revolutions, e.g., geologic time, the rock cycle, principle of faunal succession, plate tectonic theory, snowball earth theory, were ideas generated from making basic observations of geological relationships in the field. In many respects, the validity of future advances in the geological sciences depends on the fundamental geologic principles best learned and understood in the field. The renowned stratigrapher Francis Pettijohn (U of MN geology alum and author of “The Unrepentant Field Geologist”) said it best when he stated - “the rocks are the final court of appeal.” We have incorporated those words into our logo as a constant reminder of that basic truth.

Vitally important maps

The objective of field geology is to document the occurrence and spatial relationships of bedrock and unconsolidated sediments exposed at the earth’s surface, as well as projecting these data into unexposed areas on the surface and at depth into the subsurface where direct observation is impossible. From this documentation, geologists make interpretations about the geologic processes and events that occurred in the past and make predictions about where various earth resources might be found, and where and when geologic hazards might occur in the future. The most fundamental way this information is documented, interpreted, and conveyed to others is by the creation of geologic maps. A geologic map groups rocks or sediments, which are interpreted to have formed at the same time and by a similar process, into geologic units or formations. The maps include explanations that describe the range of characteristics of the rocks within each unit and their spatial and temporal relationship to other rock units. They also include information about how the rocks may have been deformed by folding and faulting.

Although geologic maps include information that is factual, such as the locations of bedrock exposures (outcrops) and the orientations of structures in the rocks, geologic maps are largely interpretive on many scales. On the outcrop scale, the rock may be too fine-grained to determine its composition, or the exposure may be too coated with lichen or moss to see the rock clearly. Since a sample cannot be taken of every rock occurrence and studied in the lab, the field geologist must make his/her best estimate of what the rock is. On the map scale, vast areas of bedrock may be buried beneath unconsolidated material (usually glacial till in Minnesota) leaving only a few outcrops as clues to the buried geology. Even in relatively well exposed areas (maybe 20% of the bedrock surface being exposed), geologic contacts or faults may not be exposed and must be inferred. Then too, the process of grouping of rocks into common units that infer similar age and process can become an iterative and interpretive exercise in lumping and splitting among rocks that commonly span a range of types. In the end, a geologic map must be considered an interpretive work of art based on some facts, quite a bit of inference, and lots of best guesses. Its final appearance is largely an interpretation that critically depends on the biases and experiences of the geologists doing the mapping. Among field geologists, a common refrain is “the one who’s seen the most rocks wins.”

Geologists speak on “the lost art”

Despite a general recognition of the primacy of field geology in the earth sciences, the training of students in the methodologies (and uncertainties) of geologic mapping and map-making has steadily declined in academia for decades to the point where it is quickly becoming a lost art. To quote some prominent geologists whom we have consulted about the need for a field mapping institute:

“Current university staff must train the succeeding generations who will populate the universities, for once field skills are lost within academia, it will be extremely difficult to recapture them. Thus time is of the essence, and it is very important to support centers where the skills are still preserved before existing staff retire and are replaced by those lacking the skills”.

Anthony J. Naldrett, Emeritus Professor of Geology, University of Toronto.

“We are perilously close to having people out there in control of all types of geological endeavors who cannot read the rocks.”

Bruce A. Marsh, Professor of Geology, Johns Hopkins University
The discipline of geologic field mapping is experience-based; it cannot be taught from a book. Rather, the best teachers of field mapping are active professional field geologists who continue to hone their field skills through to retirement and beyond. The dissemination of multifaceted field skills from active professional geologists acting as mentors to young geoscientists has always been one of the most important educational experiences of geologists. In the past, these mentors included senior personnel from the mining, mineral exploration, and petroleum industries, experienced staff from state and federal geological surveys, and faculty from colleges and universities.

However, over the last few decades the role of the geologic field mentor to young geoscientists has been dramatically diminished. The lack of field-based mentors is a function of many factors, including: (1) the globalization and cyclic nature of the mineral and petroleum industry; (2) budget cuts at state and federal geological surveys; and (3) the expanding scope of the geosciences away from the field into the laboratory (partially based on advances in technology and new theoretical concepts). These three factors have lead to fewer and fewer students choosing careers in economic geology and related hard rock fields, and many geoscience departments throughout the U.S. have been shortening or dropping courses and whole programs in minerals-related topics like economic geology, field methods, mineralogy, igneous and metamorphic petrology, and structural geology. All of these factors have had a profound negative impact on the discipline of geologic mapping.

**Who is teaching field mapping?**

The only exposure to geological mapping that most geology students in the U.S. get is during a six-week summer field camp, typically in the Rocky Mountains, between their junior and senior years of undergraduate education. In fact, in 2005, 136 of the 151 accredited geology field camps in the U.S. were held in Rocky Mountain states. The number of summer field camps has actually been declining over the years as more and more schools are not requiring field camp for a B.S. degree. While openness, relief, and good exposure of the Rocky Mountains is ideal for teaching basic principles of field mapping, the style of mapping and the type of geology emphasized at these camps do not translate directly to other types of geological terrains in other parts of the world. One very distinctive group of terrains is continental shields, which are the exposed ancient cores (cratons) of all continents. Continental shields are composed of a complex mix of rocks of Precambrian age (>540 million years), which tell the early history of how each continent was constructed. Moreover, Precambrian shields host a large percentage of the major ore deposit of the world. Minnesota lies at the southern margin of the vast, low-lying Canadian Shield, which has the added complication that it had been extensively modified and partially buried by glacial action over the past 2 million years. Mapping the glaciated Precambrian geology of the Canadian Shield requires a very unique skill set from what is typically taught in Rocky Mountain field camps.

**Demand for geologists grows**

The pullback in teaching basic field mapping skills, which is creating a dearth of well-trained field geologists, comes at a very inopportune time as there is currently a strong and growing demand for geoscientists with expertise in field mapping, especially of Precambrian terrains. This demand is evident in both the public and private sectors and both globally and locally, but it is especially urgent in the minerals exploration industry. Because of the pressure on global resource caused by the economic recovery of Western countries and rapid growth of China and other Asian economies, mineral exploration companies are gearing up for a dramatic and protracted growth in order to find new mineral resources. Increased development of current resources and exploration for new deposits is booming globally and locally, as we here in northern Minnesota well know.

Presently, about a half-dozen companies are evaluating the Cu-Ni-PGE resources of the basal Duluth Complex and other mineral deposit targets in the state. Prices for most base and precious metals are at or near historic levels. By all accounts, this growth in the mineral resource industry is expected to be sustained for a decade or more. However, the main factor acutely limiting the expansion of exploration activity is that many companies cannot find the geologists, engineers, and technicians with even the most basic skills necessary to fill these exploration and mining jobs.

It is the PRC’s mission to do our part in satisfying this demand by supplying geoscience students who are well-trained in mapping methodologies best-suited for geologic field studies of the Canadian Shield and similar terrains.
The Precambrian Research Center is being established as a research and teaching institute that is supervised by two University of Minnesota Duluth departments: the Department of Geological Sciences within the College of Science and Engineering and the Natural Resources Research Institute’s (NRRI) Center for Applied Research and Technology Development. The roles of these supervising institutions are distinct in that the business and financial elements of the PRC will be supervised and assisted by the NRRI, whereas educational and student support elements will be supervised by the geology department. Day-to-day management of the PRC programs will be overseen by its two directors – Drs. Dean Peterson and Jim Miller. Dean is a senior research associate with NRRI and is director in charge of Program Design and Conceptualization. Jim is an associate professor in the Department of Geological Sciences and serves as the PRC’s administrative director. Dr. George Hudak, an associate professor at the University of Wisconsin at Oshkosh, serves as associate PRC director assisting in planning and teaching field camp and professional workshops.

Decisions about the scope and focus of PRC programs will benefit from input from several groups of advisors and collaborators. A regular source of advice and oversight will come from an ad hoc PRC working group of UMD faculty and NRRI staff, who have an interest in the PRC’s mission and goals. The Minnesota Geological Survey will serve as source of counsel and instruction assistance for the field camp. A third, more formal source of advice will come from a Board of Advisors which will serve as a vehicle for communication and interaction between the PRC, academia, geological surveys, and the mineral industry. Also, we will periodically tap experts from industry, government, and academia to collaborate on various PRC programs, especially field camp and professional workshops.
BOARD of ADVISORS

Donald Fosnacht, Director, NRRI Center for Applied Research and Development
Howard Mooers, Head, Department of Geological Sciences
Harvey Thorleifson, Director, Minnesota Geological Survey
William Cannon, Senior Geologist, U.S. Geological Survey - Reston
Alan Bailes, Chief Geologist, Manitoba Geological Survey
Anthony Naldrett, Emeritus Professor of Geology, University of Toronto
James Franklin, formerly Chief Scientist, Geological Survey of Canada
Bruce Marsh, Professor of Geology, Johns Hopkins University
Odin Christensen, former Chief Geologist, Newmont Mining Corporation
Alan Soever, President, Wallbridge Mining Company

FISCAL STRUCTURE

The administrative and programmatic costs of PRC activities are funded through a combination of grants and contributions from public and private industry sources. Public sources of funding include grants or in-kind contributions from the University of Minnesota entities (NRRI, UMD’s College of Science and Engineering, Minnesota Geological Survey), state funding agencies (e.g., Iron Range Resources, Minerals Coordinating Committee of the MN State Legislature, Legislative Commission on Minnesota Resources, ...) and from federal funding sources (e.g., National Science Foundation, U.S. Geological Survey, Department of Energy, ...). Private sources of funding come from tax-deductible corporate and individual membership contributions to the PRC foundation and from direct corporate sponsorship of graduate student research at UMD. Whereas public sources of funding will be used to pay for administrative and some programmatic costs, private funding will be used exclusively for programmatic costs directed toward training students in field mapping skills (see Membership page for more details).
2007 Field Camp Participants

- **Brian Lentz**
  - Winona State University, MN
  - Stillwater, MN
  - BS completed 1/08, presently looking for employment in exploration

- **Tyler Fellows**
  - U Wisconsin - Milwaukee, WI
  - LaCrosse, WI
  - BS expected 5/08

- **Shelby Frost**
  - Winona State University, MN
  - LaCrosse, WI
  - BS expected 5/08, accepted into UMD MS program

- **Natalie Juda**
  - Macalester College, St. Paul, MN
  - Natick, MA
  - Employed by Golden Chalice Resources, Timmins, ON

- **Dean Moosavi**
  - U New Hampshire
  - Mankato, MN
  - Assistant Professor, Dept of Earth & Env Sci, Tulane University

- **Benedek Gal**
  - Eötvös Loránd Univ, Budapest, Hungary
  - Completing MS degree in Hungary

- **Amanda Putz**
  - UMD
  - St. Cloud, MN
  - BA received 8/07

- **Gabriel Sweet**
  - Macalester College, St. Paul, MN
  - Lexington, MA
  - BS received 5/07, accepted into Lakehead U MS program

- **Erik Tharalson**
  - UMD
  - Duluth, MN
  - Employed by Encampment Resources, Babbitt, MN

- **Natalie Juda**
  - Macalester College, St. Paul, MN
  - Natick, MA
  - Employed by Golden Chalice Resources, Timmins, ON

- **Erik Tharalson**
  - UMD
  - Duluth, MN
  - Employed by Encampment Resources, Babbitt, MN

- **Steven Hoaglund**
  - U Wisconsin - Eau Claire, WI
  - Eagan, MN
  - 1st Year MS Candidate, UMD

- **Corey Wendland**
  - UMD
  - Amboy, MN
  - BA received 5/07, accepted into Lakehead U MS program

- **Dean Moosavi**
  - U New Hampshire
  - Mankato, MN
  - Assistant Professor, Dept of Earth & Env Sci, Tulane University

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The PRC field camp gave me a great advantage. We looked at and mapped the exact rock types that I deal with everyday at TeckCominco (olivine gabbro, troctolite, BIF, etc). Also, the experience of working with and logging drill core made learning my job a lot easier. They use ArcGIS to put together their maps/cross sections and they were pleased to hear I had experience working with this program. I definitely think if a student has plans to work in the mining industry, the PRC field camp is ideal. – Ashley Anderson

Ashley Anderson received her B.S. degree in Geology from UMD in December 2007. She was recently hired by Teck Cominco as a geotechnical assistant working on the Mesabi Cu-Ni-PGE deposit along the base of the Duluth Complex.

“Participating in the PRC field camp allowed me to develop the skills necessary for working in a Precambrian terrain and the confidence to do my job in exploration geology with the necessary detail. I was able to show the job representatives examples of the maps I created, which gave them the reassurance that I knew how to map an area with great skills taught by some of the best geologist in the field. – Corey Wendland

Corey received his B.S. in Geology from UMD in May of 2007. This past fall, he was accepted into the Master’s program at Lakehead University in Thunder Bay, Ontario under the supervision of Dr. Peter Hollings. Corey is working on a diamond-bearing lamprophyre and associated placer prospect for his M.S thesis and has recently signed on with Zinifex to work on a VMS prospect in Nunavut Province.

“I have to say that without a doubt the PRC camp was a rewarding experience that continues to pay back dividends. My master’s research in Archean rocks is rooted in the skills I learned at the PRC camp.” – Tom Johnson

Tom is a first year M.S. graduate student at UMD, who will be working on the structure, alteration, and mineralization associated with a major Archean shear zone in the Vermilion District for his thesis research.

“The training I received at field camp has been very helpful in the exploration world, not only the technical skills, but the confidence I gained as well.” – Troy Boisjoli

Troy is a native Canadian, who received his B.S. in geology from St. Norbert’s College in Wisconsin. Since the fall of 2007, he has been working as an Exploration Geologist for Cameco Corp., a uranium company based out of Saskatoon, Saskatchewan.

“The capstone project may have been my favorite part of field camp. It combined my three passions in life: field geology, canoeing and camping. Not to mention, it was incredible to work with Mark Jirsa, a professional field geologist, who currently works for the Minnesota Geological Survey. He was hands-on enough to help us understand the terrain, but also let us work independently so we could formulate ideas of our own and figure out the problem. It was refreshing to hear points of view from a man who works in the field for his living. Just an incredible experience.” – Amanda Putz

Amanda received her B.A. from UMD in 2007. She is currently living in the Twin Cities and looking for work in the geosciences.

“The field camp experience has been extremely helpful allowing me to jump right into logging core, as I had already seen the rocks and minerals in outcrop.... Also, the final, chaotic week in the computer lab has come in handy while working with our ArcMap database. I really feel that the experiences during field camp have already helped me and will continue to aid me in the future.” – Erik Tharalson

Erik Tharalson received his B.S. in Geology from UMD in December 2007. He was recently hired by Encampment Resources as a junior exploration geologist working on the South Filson Creek Cu-Ni-PGE deposit and other exploration targets in the Duluth Complex.
Program Reports

Precambrian Field Camp
Web page: www.d.umn.edu/prc/fieldcamp
In the summer of 2007, the educational mission of the PRC was officially launched with the successful completion of the first Precambrian field camp – the centerpiece of the PRC programs. The camp was held July 15 through August 25 and was attended by 15 students, mainly from Minnesota and Wisconsin schools. Instructors for the camp, in addition to the PRC directors included George Hudak (UW-Oshkosh), John Goodge (UMD), Mark Severson (NRRI), Mark Jirsa (MGS), Val Chandler (MGS), Howard Mooers (UMD), Terry Boerboom (MGS), Al Knaeble (MGS), Phil Larson (Cleveland Cliffs), and Nigel Watrous (UMD).

The six-week field camp focused exclusively on geologic mapping in the diverse Precambrian terranes of northeastern Minnesota. While students were trained in basic field mapping methods taught in most field camps, this camp put a greater emphasis on igneous and metamorphic terranes and by introducing students to techniques such as core logging, surficial (glacial) mapping, and geophysical surveying, which are particularly useful in geologic mapping and mineral prospecting in glaciated Precambrian cratons. Students were also introduced to the unique challenges of the navigating in boreal landscapes of the southern Canadian Shield.

2007 Precambrian Field Camp Highlights
• Field mapping in diverse Precambrian terrains, including deformed metasedimentary rocks, layered mafic intrusions, plateau lavas and subvolcanic intrusions, banded iron-formation sequences, granitic plutons, archean greenstone belts and shear zones.
• Mapping at various scales - outcrop (1:250) to quadrangle (1:24,000).
• Recognizing metamorphic grade, deformational fabrics, alteration assemblages, and ore mineralization in the field.
• Acquiring geophysical field measurements for interpreting bedrock geology.
• Mapping glacial deposits & landforms and introduction to drift prospecting.
• Drill core logging of banded iron formation stratigraphy.
• Drift mapping in an underground iron mine (1/2 mile below surface).
• GIS compilation of field data (in ArcView) and digital map-making (in Illustrator).
• CAPSTONE MAPPING PROJECT – Students were divided into field parties of 2-5 students and an instructor during Week 5 to conduct detailed mapping in four different geological terrains. The project areas had not been previously mapped in detail and required backwoods field work, primitive camping and canoeing in a wilderness setting.

The true measure of the success of the camp is how the students have taken advantage of this experience to better their academic and career goals. Of the 15 students, four have secured jobs with exploration companies (Teck Cominco, Cameco, Golden Chalice Resources, Encampment Minerals), seven are pursuing Master’s degrees (four at UMD, two at Lakehead University in Thunder Bay, and one at Eötvös Loránd University, Budapest, Hungary), three are currently finishing their undergraduate degrees with one admitted to UMD next term for graduate studies.

Activities in the last half of the year have focused on finalizing the accounting for the camp, updating the Web site, preparing the advertising poster for next year’s camp, promoting the camp with visits to local colleges, and discussing the PRC programs with colleagues from throughout the country (Johns Hopkins University, Colgate University, University of Idaho, University of Hawaii, Office of Polar Programs – National Science Foundation). As we did last year, field camp posters were mailed around the first of the year to over 250 geology departments in the U.S. and Canada. The school visits this year included new visits to the U of MN-Twin Cities, Carleton College, University of North Dakota, and North Dakota State, as well as University of Wisconsin-Eau Claire, Winona State, St. Thomas, and University of Wisconsin-River Falls, which were visited last year. Associate Director, George Hudak is planning to visit schools in Wisconsin, including Lawrence (Appleton) and University of Wisconsin-Milwaukee this winter. In November, an oral presentation on the field camp was given at a special session on the future of field camps at the national Geological Society of America meeting in Denver. The talk highlighted the unique aspects of the PRC camp relative to traditional Rocky Mountain-based field camps.

The final operational costs for the camp came in under the estimated costs (~ $83,072, actual: $78,556), although over $16,000 was spent for curriculum preparation and the purchase of permanent field equipment (bruntons, GPS’s, cameras, 2-way radios, etc.). Considerable time and money was spent by the directors in preparing initial project maps, which will not be an expense next year.

Professional Workshops
Web page: www.d.umn.edu/prc/workshops
This component of the PRC program has had some difficulty getting off the ground. Two workshops originally planned for the fall of 2007 had to be postponed until this coming spring due to inadequate registration. One workshop, rescheduled for April 23-24, 2008, is a primer on the geology and Cu-Ni-PGE resources of the Duluth Complex and new developments on the Mesaba Iron Range intended for the investment community. The
second workshop, rescheduled for May 11-17, 2008, is a short course and field excursion highlighting the physical volcanology of volcanic and volcaniclastic rocks of Archean greenstone belts and their hydrothermal alteration, mineralization, and metamorphism. We have been actively advertising these both workshops in trade publications (Northern Miner, SEG Newsletter, and Skillings). We will be promoting both workshops heavily at the Prospector’s and Developers Association Convention in Toronto this coming March. We have every confidence that both upcoming workshops will be fully registered and successful.

We decided to cut back from our original plan of offering two workshops per year, to running just one in the spring. Fall is prime field time for most exploration geologists, who would be most interested in the workshops. Moreover, with the intense six week field camp over the summer, it is a challenge to keep up with the planning that is necessary to put on an early fall workshop. The spring workshop will be held around the time of the Institute on Lake Superior Geology meeting, which will be a good venue for our annual board of directors meeting. This year the ILSG is being held in Marquette, Michigan, May 7-10. The greenstone volcanology workshop will take place the following week in Duluth. Plans are already underway to hold a workshop on mapping mafic layered intrusions in May of 2009.

Student Grants
Web pages: www.d.umn.edu/prc/gradresearch and www.d.umn.edu/prc/grants
The first PRC Graduate Research Assistantship was awarded this fall to Chris White. Chris, who came to UMD from University of Wisconsin-Oshkosh, is in the second and final year of his Master of Science degree program. His thesis study will attempt to establish the magmatic and mineralization history of Duluth Metals Limited’s Nokomis Cu-Ni-PGE deposit within the South Kewishiwi Intrusion of the Duluth Complex. The cost of this nine-month research assistantship (which includes a 50 percent salary, health benefits, and tuition waiver) was $24,775 and was paid from the PRC Foundation Fund. We hope to be able to award two assistantships next year and fund a number of small research grants (up to $1,000 each) to students conducting field-based research on Precambrian geology in the Lake Superior region. Notices of the research grant program were recently sent out to 25 geology departments in the Midwest U.S. and Ontario.

Other Activities
The PRC successfully assisted students in finding employment or graduate programs in Precambrian geology-related fields. Students who found jobs in the mineral exploration industry were aided by staff connections and/or recommendations. Two field camp students pursuing Master’s degrees in economic geology at Lakehead University were directed there and accepted with staff recommendations. Guidance in economic geology job opportunities in the area was given to other UMD graduate and undergraduate students, as well as past UMD students.

Other initiatives include two types of outreach activities that explain Lake Superior geology and mineral resources to the general public. One leads an annual fall field trip on the Precambrian geology of northeastern Minnesota for students and faculty from Upper Midwest and Northwest Ontario geology programs. The other assists in K-12 teacher workshops.

For the past two years, the PRC has offered a weekend field trip on the classic geology of northeastern Minnesota with all meals and camping fees paid. These trips are held in October and involved 15 students in 2006 and eight students in 2007. We expect this to be an annual event.

PRC staff will be involved in two teachers’ workshops next summer. One is the TIMES (Teaching Inquiry Methods in Earth Sciences) project, a two-week field course organized annually by the Science Museum of Minnesota to train Middle and High school earth science teachers in inquiry-based learning through field experiences. About 20 teachers from throughout the state will be involved in this field-intensive workshop.

The other workshop is the 12th annual Minnesota Minerals Education Workshop, which will be held in Ely during the same time at Vermilion Community College. This two-and-a-half day workshop gives K-12 teachers educational resources, lesson plans ideas, and background information in order to introduce students to their local geology and mineral resources.
PRC Corporate and Individual Donor Memberships

One of the major sources of funding for the educational components of the PRC will come from corporate and individual donations. The minerals industry stands to be the primary beneficiary of the PRC’s student training and support in modern field methods and map-making, and we look to the minerals industry to serve as the PRC’s principal benefactor. To sustain our long-term success, we ask mineral resource companies and individuals related to the minerals industry to become corporate or professional members of the PRC at one of the levels listed below.

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<td>X</td>
<td>1</td>
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<tr>
<td>Palladium</td>
<td>Individual</td>
<td>&gt;$5,001</td>
<td>X</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Titanium</td>
<td>Individual</td>
<td>$5,000-2,001</td>
<td>X</td>
<td>1</td>
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<tr>
<td>Nickel</td>
<td>Individual</td>
<td>$2,000-501</td>
<td>X</td>
<td>1 per year</td>
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<tr>
<td>Zinc</td>
<td>Individual</td>
<td>&lt;$500</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The benefits of PRC membership are:
- Contributions will be acknowledged as tax-deductible gifts to the University of Minnesota.
- Members have open access to students for employment and company-directed research opportunities.
- Guaranteed slots are reserved for each professional.
- Receipt of annual report on PRC finances and educational activities.
- Diamond, corporate and palladium individual members are awarded a position on the board of advisors.

Annual membership contributions are deposited into the PRC Foundation gift account held by the College of Science and Engineering at the University of Minnesota Duluth. Funds from the PRC Foundation account are used exclusively to support educational programs that directly benefit students. The programs supported by these funds, in order of priority, are:

**Graduate Research Assistantships** – These are nine-month assistantships, which include salary (50-percent time), health benefits, and a tuition waiver awarded to M.S. and Ph.D. graduate students at UMD to support field-based dissertation projects in Precambrian geology. They are typically awarded in the second year of a M.S. degree program, and in the third or fourth year of a Ph.D. degree program. A Graduate Research Assistantship for the 2006-2007 academic year totaled about $25,000 per student. When funding allows, the PRC would like to make up to four Assistantships available each year.

**Research Grants** – These are small grants ($1,000-$5,000) available to undergraduate or graduate students conducting Precambrian field studies in the Lake Superior region. They are open to students from any college with an accredited geology department. Applications are reviewed in spring of each year. The amount of research grants awarded each year will depend on the funds available from the PRC Foundation Account.

**Precambrian Field Camp** – In order to keep field camp tuition affordable and competitive with other summer field camps, the PRC expects to subsidize some of the costs of the field camp through PRC Foundation funds. Last summer’s camp charged $25,000 for tuition and fees, which covered approximately 38% of the camp costs. $20,000 was used from the PRC Foundation account and the remainder was covered by base funding from the NRRI. Next summer, tuition and fees will be increased to $29,000.

**Outreach Activities** – PRC Foundation funds may also be used for supporting outreach activities that highlight the geology and mineral resources of the Lake Superior region. These activities may be directed toward area colleges (e.g., conducting field trips in the Lake Superior area for visiting student groups; sponsorship of lectures on Precambrian field geology), to K-12 educators and students (e.g., school visits, workshops), and to the general public (adult education classes, public lectures).
Inaugural Members

<table>
<thead>
<tr>
<th>Corporate Members</th>
<th>Membership Level</th>
<th>Initiated</th>
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</thead>
<tbody>
<tr>
<td>Anglo American plc</td>
<td>Platinum</td>
<td>April 2007</td>
</tr>
<tr>
<td>Cleveland-Cliffs Inc.</td>
<td>Platinum</td>
<td>August 2007</td>
</tr>
<tr>
<td>Newmont Mining Corp</td>
<td>Gold</td>
<td>May 2007</td>
</tr>
<tr>
<td>Duluth Metals Limited</td>
<td>Gold</td>
<td>June 2007</td>
</tr>
<tr>
<td>Rendrag Inc.</td>
<td>Copper</td>
<td>April 2007</td>
</tr>
<tr>
<td>Freewest Resources Canada Inc.</td>
<td>Copper</td>
<td>July 2007</td>
</tr>
<tr>
<td><strong>Total Corporate Donations</strong></td>
<td></td>
<td>$48,200</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Individual Members</th>
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</thead>
<tbody>
<tr>
<td>Tom Gardner</td>
<td>Palladium</td>
<td>June 2007</td>
</tr>
<tr>
<td>Al MacTavish</td>
<td>Titanium</td>
<td>April 2007</td>
</tr>
<tr>
<td>Richard Patelke</td>
<td>Titanium</td>
<td>July 2007</td>
</tr>
<tr>
<td><strong>Total Individual Donations</strong></td>
<td></td>
<td>$27,000</td>
</tr>
</tbody>
</table>

| Anonymous Match                           | ($15,000)        |             |

| Total 2007 Contributions                  | $90,200          |             |
### Financial Statement (July 2006 - December 2007)

**Income**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Minnesota Duluth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Resources Research Institute (FY2006)</td>
<td>50,000</td>
<td>16.9%</td>
</tr>
<tr>
<td>Natural Resources Research Institute (FY2007)</td>
<td>100,000</td>
<td>33.9%</td>
</tr>
<tr>
<td>UMD College of Science and Engineering (FY2006)</td>
<td>25,000</td>
<td>8.5%</td>
</tr>
<tr>
<td>Precambrian Field Camp - Tuition &amp; Fees (15 students)</td>
<td>29,800</td>
<td>10.1%</td>
</tr>
<tr>
<td><strong>UMD Subtotal</strong></td>
<td><strong>204,800</strong></td>
<td><strong>69.4%</strong></td>
</tr>
<tr>
<td>PRC Foundation Account</td>
<td></td>
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</tr>
<tr>
<td>Corporate Membership contributions (6 companies)</td>
<td>48,200</td>
<td>16.3%</td>
</tr>
<tr>
<td>Individual Membership contributions (3 individuals)</td>
<td>27,000</td>
<td>9.2%</td>
</tr>
<tr>
<td>Anonymous Match (1 individual)</td>
<td>15,000</td>
<td>5.1%</td>
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<tr>
<td><strong>Foundation Subtotal</strong></td>
<td><strong>90,200</strong></td>
<td><strong>30.6%</strong></td>
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<tr>
<td><strong>TOTAL INCOME</strong></td>
<td><strong>295,000</strong></td>
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**Expenses**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Director’s Salaries (excluding field camp)</td>
<td>45,670</td>
<td>24.9%</td>
</tr>
<tr>
<td>Precambrian Field Camp</td>
<td>78,556</td>
<td>42.8%</td>
</tr>
<tr>
<td>Field Camp Preparation</td>
<td>16,279</td>
<td>8.9%</td>
</tr>
<tr>
<td>Professional Workshops</td>
<td>2,551</td>
<td>1.4%</td>
</tr>
<tr>
<td>Graduate Research Assistantships and Research Grants</td>
<td>24,775</td>
<td>13.5%</td>
</tr>
<tr>
<td>Promotion and Fundraising</td>
<td>11,921</td>
<td>6.5%</td>
</tr>
<tr>
<td>Other Expenses</td>
<td>3,575</td>
<td>2.0%</td>
</tr>
<tr>
<td><strong>TOTAL EXPENSES</strong></td>
<td><strong>183,328</strong></td>
<td></td>
</tr>
<tr>
<td><strong>YEAR END BALANCE</strong></td>
<td><strong>111,672</strong></td>
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</tr>
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</table>
The general goals of the PRC for the coming year are to build upon the successes and learn from the challenges of the inaugural year. The specific goals for the various PRC programs and activities in 2008 are:

**Precambrian Field Camp** – Achieve full registration (20 students), improve some of the exercise elements, prepare more background information, hire a teaching assistant, reduce per student operational costs by at least 5 percent.

**Professional Workshops** – Successfully conduct, within budget, the first PRC professional workshops in April and May; plan, prepare, and promote the second workshop to be held in May of 2009 (topic: Field Studies of Mafic Layered Intrusions); develop the capacity to accept credit card payment for future workshop registrations.

**Graduate Research Assistantships and Research Grants** – Offer up to two graduate research assistantships to UMD Master of Science students during the 2008-2009 academic year; provide at least $15,000 in funding in research grants for undergraduates and graduate students for summer field work.

**UMD Course Offerings** – Submit course proposal for an upper level course on 3-D digital map making; request to expand the Geologic Maps course to allow a graduate level track.

**Outreach** – Successfully conduct two K-12 teacher workshops during the summer (TIMES project in June, MMEW workshop in August); attract new geology departments to take part in the Annual Fall Field Trip on the Classic Precambrian Geology of Northeastern Minnesota.

**Promotion at Meetings** – Attend and give presentations at the Prospectors and Developers Association Convention in Toronto (March), Society of Mining, Metallurgy and Exploration meeting in Duluth (April), Institute on Lake Superior Geology in Marquette, MI (May), the Geological Society of America Meeting in Portland, OR (October), and possibly, the Northwest Mining Association Convention in Spokane (December).

**Promotion at Schools** – Visit at least three new schools during the fall semester PRC field camp promotional tour of upper Midwest colleges and universities.

**Graduate Student Recruitment** – Attract at least four new graduate students to the UMD graduate program to conduct field-based thesis research on Precambrian geology by exposing them to the area geology through field camp, providing PRC research grants to non-UMD undergraduates, visiting area colleges, and giving presentations at professional meetings.

**Student Career Planning** – Make students aware of employment opportunities in the public and private sector and of academic geology programs that promote field-based research; maintain and develop new relationships with mineral exploration and mining companies operating globally as well as locally.

**Public Sector Fundraising** – Follow through with an earlier proposal to the Iron Range Resource agency to establish a program to match private donations to the PRC with public funds; investigate funding possibilities through the U.S. Geological Survey’s National Cooperative Geologic Mapping Program.

**Private Sector Fundraising** – Double last year’s contributions to the PRC Foundation account to $200,000 by 1) inviting current PRC members to renew their memberships for 2008 and 2) recruiting new corporate and individual membership through distribution of information and personal appeals at the Prospectors and Developers Association, Society of Mining, Metallurgy and Exploration, and Northwest Mining Association meetings, follow-up phone calls, and direct and email solicitations.

Looking Forward to Year Two: 2008 Goals
# Faculty and Staff

## Directors

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation/Position/Title</th>
<th>PRC Role/GEOLOGICAL EXPERTISE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Miller</td>
<td>Department of Geological Sciences &amp; NRRI, Associate Professor</td>
<td>Administrative Director, Igneous Petrology, Economic Geology</td>
</tr>
<tr>
<td>Dean Peterson</td>
<td>Natural Resources Research Institute, Senior Research Associate</td>
<td>Program Design and Conceptualization Director, Economic Geology, GIS, 3D Visualization</td>
</tr>
<tr>
<td>George Hudak</td>
<td>Department of Geology, Univ. Wisconsin-Oshkosh, Associate Professor</td>
<td>Associate Director, Economic Geology, Mineralogy Volcanology</td>
</tr>
</tbody>
</table>

## Business Group

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation/Position/Title</th>
<th>PRC Role/GEOLOGICAL EXPERTISE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tricia Bunten</td>
<td>Swenson College of Science and Engineering, Development Officer</td>
<td>PRC Foundation Account Manager</td>
</tr>
<tr>
<td>Denise Endicott</td>
<td>Natural Resources Research Institute, Senior Accounting Supervisor</td>
<td>Accounts Manager</td>
</tr>
<tr>
<td>Julie Heinz</td>
<td>Natural Resources Research Institute, Executive Office &amp; Admin. Specialist</td>
<td>Administrative Secretary</td>
</tr>
<tr>
<td>June Kallestad</td>
<td>Natural Resources Research Institute, Public Relations Manager</td>
<td>Publications - Editing</td>
</tr>
<tr>
<td>Trish Sodahl</td>
<td>Natural Resources Research Institute, Associate Administrator</td>
<td>Publications - Layout and Design</td>
</tr>
</tbody>
</table>

## PRC Working Group

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation/Position/Title</th>
<th>PRC Role/GEOLOGICAL EXPERTISE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don Fosnacht</td>
<td>Natural Resources Research Institute, Departmental Director - CARTD</td>
<td>Business Supervisor, Metallurgical Engineering</td>
</tr>
<tr>
<td>Howard Mooers</td>
<td>Department of Geological Sciences, Department Head, Professor</td>
<td>Educational Supervisor, Field Camp Instructor, Glacial Geology, Astronomy</td>
</tr>
<tr>
<td>Christina Gallup</td>
<td>Department of Geological Sciences, Associate Professor</td>
<td>Student Advisor, Geochronology, Geochemistry</td>
</tr>
<tr>
<td>John Goodge</td>
<td>Department of Geological Sciences, Professor</td>
<td>Field Camp Instructor, Student Advisor, Metamorphic Petrology, Geotectonics</td>
</tr>
<tr>
<td>Vicki Hansen</td>
<td>Department of Geological Sciences, Professor</td>
<td>Geologic Maps Course Instructor, Student Advisor, Structural Geology, Planetary Geology</td>
</tr>
<tr>
<td>Steve Hauck</td>
<td>Natural Resources Research Institute, Program Director, Economic Geology Group</td>
<td>Business Advisor, Economic Geology, Mineralogy</td>
</tr>
<tr>
<td>Tim Holst</td>
<td>Swenson College of Science and Engineering, Associate Dean</td>
<td>Educational Advisor, Structural Geology</td>
</tr>
<tr>
<td>Penny Morton</td>
<td>Department of Geological Sciences, Associate Professor, Director of Grad Studies</td>
<td>Graduate Student Advisor, Mineralogy, Economic Geology</td>
</tr>
<tr>
<td>Ron Morton</td>
<td>Department of Geological Sciences, Professor</td>
<td>Workshop Instructor, Student Advisor, Economic Geology, Volcanology</td>
</tr>
<tr>
<td>Mark Severson</td>
<td>Natural Resources Research Institute, Research Fellow</td>
<td>Field Camp Instructor, Economic Geology</td>
</tr>
<tr>
<td>Nigel Wattrus</td>
<td>Dept of Geological Sci. &amp; Large Lakes Observatory, Research Fellow</td>
<td>Field Camp Instructor, Student Advisor, Geophysics</td>
</tr>
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</table>

## Affiliated Staff

<table>
<thead>
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<th>Name</th>
<th>Affiliation/Position/Title</th>
<th>PRC Role/GEOLOGICAL EXPERTISE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terry Boerboom</td>
<td>Minnesota Geological Survey, Senior Scientist</td>
<td>Field Camp Instructor, Precambrian Geology</td>
</tr>
<tr>
<td>Val Chandler</td>
<td>Minnesota Geological Survey, Senior Scientist</td>
<td>Field Camp Instructor, Geophysics</td>
</tr>
<tr>
<td>Mark Jirsa</td>
<td>Minnesota Geological Survey, Senior Scientist</td>
<td>Field Camp Instructor, Precambrian Geology</td>
</tr>
<tr>
<td>Al Knaeble</td>
<td>Minnesota Geological Survey, Senior Scientist</td>
<td>Field Camp Instructor, Quaternary Geology</td>
</tr>
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Student Generated Maps
The University of Minnesota is an equal opportunity educator and employer.