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The Geological Society of Minnesota News

Volunteer opportunities, field trips, lectures, and public service, since 1938

From the President's Desk…

My term as President started at the beginning of this year, and I am looking forward to serving in the role. Special thanks to Theresa Tweet who served so well as President last year, and has been giving me much encouragement and advice as her terms as President and Board member end. Thanks also to Allan Bowles and Alan Smith, whose Board terms also expire but who continue to contribute to GSM in other important ways.

I'd like to speak a bit about our Board. The Board consists of GSM members who have a special interest in advancing the goals of our society, which include lectures, field trips, and community outreach. The Board currently has nine members, listed elsewhere in this newsletter. Our bylaws limit the terms of Board members to four years. We do that to encourage a turnover of perspectives and ideas. This year the Board will meet quarterly, with meeting dates scheduled on the Thursdays of February 13, May 8, August 14, and November 13. We typically meet between 7:00 & 9:00 PM at the Minnesota Geological Survey building (2642 University Ave. W. in St. Paul). These meetings are open to all members of GSM. So, whether you are a new member of GSM or have been a member for many years, if Board membership is something that might interest you, or you are just curious to see how the Board works, I encourage you to attend a meeting. And if you have a topic you would like the Board to consider, contact me about getting it on the agenda.

GSM President, Dave Wilhelm

Besides Board membership, there are other important roles that GSM members fulfill. Two currently open are Video Librarian and Field Trip Coordinator.

I served as Video Librarian for the past two years, after many years of admirable service by Randy Strobel, who built the majority of the collection of over 160 quality DVD titles. I am continuing as Video Librarian until someone else steps up, but as President would prefer to pass this function on to other capable hands. We are in the process of upgrading the Video Library in an important way: The list of DVD titles and descriptions will very soon be available on our web site. The data entry has been completed; many thanks to Sherry Keesey for that contribution. Alan Smith and I are working out the final details for getting this on the web site. Once that is accomplished, you will be able to

Upper photograph: GSM field trip to Minnehaha Falls, July 12, 1942

Inside this issue:

from the archives: A trip to Brown County, circa 1939.

pursue the library's offerings from the comfort of home.

Field Trip Coordinator is a role which has been vacant for some time. Note that the intent of this role is not necessarily to plan the field trips themselves, but to coordinate the activities of those who do, and to get trip suggestions from our membership. Trips can be anywhere from a few hours to local places of interest to a week or longer at a farther destination. (Over the past few years, we have had great longer trips to Colorado, Kentucky, Wisconsin, Michigan, and California. Special thanks to Randy Strobel, Joan Furlong, Bill Robbins, and Ed & Sandy Steffner for researching and arranging those.)

Finally, let me encourage you to regularly visit our web site (gsmn.org) for the latest information about our activities, plus a wealth of historical information.

Dave Wilhelm

GSM News

Officers:
Dave Wilhelm, President
Sherry Keesey, Treasurer
John Grams, Secretary

Board Members: Mary Inskeep; Deb Preece; Ruth Jensen; Rebecca Galkiewicz; Mark Ryan; and Roger Benepe

Editors: Katy Paul; Harvey Thorleifson; Rich Lively

The Geological Society of Minnesota is a 501(c)3 nonprofit organization. The purpose of this newsletter is to inform members and friends of activities of interest to the Geological Society of Minnesota.

Send all GSM membership dues, change of address cards, and renewals to:
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P.O. Box 390555
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Membership dues are: $10 Full-time students; $20 Individuals; $30 Families

GSM News is published four times a year: **February 15, May 15, August 15, and November 15**. Deadline for article submission is the first of the month, before the date of publication.

Send all material to:
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Welcome, New GSM Board!

2014 BOARD MEMBERS

Dave Wilhelm, President
John Grams, Secretary
Sherry Keesey, Treasurer
Mary Helen Inskeep
Deb Preece
Ruth Jensen
Rebecca Galkiewicz
Mark Ryan
Roger Benepe

Spring Banquet Update

As of this newsletter's publication date, we do not have a location for our Spring Banquet. Once we have decided on a new venue we will announce it at lectures, and it will be listed on our Website. The current scheduled date for the banquet is **May 5**. This date may change depending on whether we find a suitable location, or if we have a similar event instead of the banquet (pot-luck, picnic, etc.). Please check the website for future details.

2014 Lecture Information

LOCATION: The remaining lectures of our 2013-2014 series will continue to be held at the same site as last fall: Room 3-210 of Keller Hall, also called the Electrical Engineering/Computer Science building. Keller Hall is located at 200 Union St. SE near the corner of Washington Ave. and Union St. on the University's East Bank campus.

Schedule Change:

The topic of the May 5th lecture by Mark Jirsa has changed to the following:

MAPPING MINNESOTA'S PRECAMBRIAN BEDROCK:
Primer, history, methods, examples, and relevance

This presentation is an outgrowth of one created recently to enlighten newly hired members of the Minnesota Geological Survey. It summarizes the various methods and rationales for mapping the State's Precambrian bedrock, highlighting specific projects that utilized myriad GIS-capable data sources. These projects contribute to understanding the protracted geologic history of Minnesota and its resource endowment.

Mark Jirsa is a senior scientist and geologic mapper with the Minnesota Geological Survey—a research, outreach, and teaching branch of the University of Minnesota. He obtained a BS degree from the University of Wisconsin, and an MS from the University of Minnesota-Duluth (1980). Mapping and research utilizes the combination of geophysical, drilling, and outcrop information to improve and convey the understanding of Minnesota's ancient bedrock crust. Author/coauthor of more than 100 maps and other publications.

In Memoriam
Goldie Johnson
January 27, 2014

We were saddened to learn of long-time GSM Member Goldie Johnson's death, on January 27th at the age of 86. Goldie and her husband George, who preceded her in death, were active members of GSM for many years, with George serving as GSM President in 1984. Goldie hosted many December Pot-Luck gatherings of the GSM at her home in rural Wyoming, MN, along with summer get-togethers with boat rides on the lake. Goldie was born in Detroit, MI, and grew up in Pelican Rapids, MN.

NOTES FROM THE PAST

From the Sept/Oct 1949 edition of
The Minnesota Geologist, the Official Bulletin of the Geological Society of Minnesota

Editors Memo: We are pleased to announce that after many months of planning and work, the first Geological bronze tablet to be erected by our Society, in Minnesota, is ready and will be mounted in granite by the State Highway Dept. at an outlook on the St. Croix at Taylors Falls. This sign will be dedicated to the memory of our founder, Edward P. Burch. A dedicatory program and field trip will be held on Sunday, October 30. Mr. Lawrence W. King, with the help and cooperation of Dr. George A. Thiel, Chairman of the Department of Geology at the University of Minnesota who compiled the geological data, also made all other arrangements. We, the members, can be justly proud of supporting this worthwhile project. This we hope, is the first of similar signs to be erected throughout the state by our Society.

GSM MEMBERS VISIT ICELAND – PART II
By Dave Wilhelm

As I reported in the previous newsletter, a number of GSM members participated in a Chautauqua to Iceland. After the formal trip ended, four of us (Diane Lentsch, Mary Kay Arthur, Tom Higgins, and I) stayed an additional two days. The highlight of this additional time was an airplane excursion over southwest Iceland that included a land tour of Heimaey in the Westman Islands.

Our four-passenger plane departed from Reykjavík's municipal airport, which handles only domestic flights (and flights to Greenland). We got an expansive view of Reykjavík on take-off, and a flyby of the geothermal power plant we had toured

Heimaey Harbor

a few days earlier. We then flew overland (seeing farmsteads, serpentine rivers, and black volcanic beaches) to the Westman Islands.

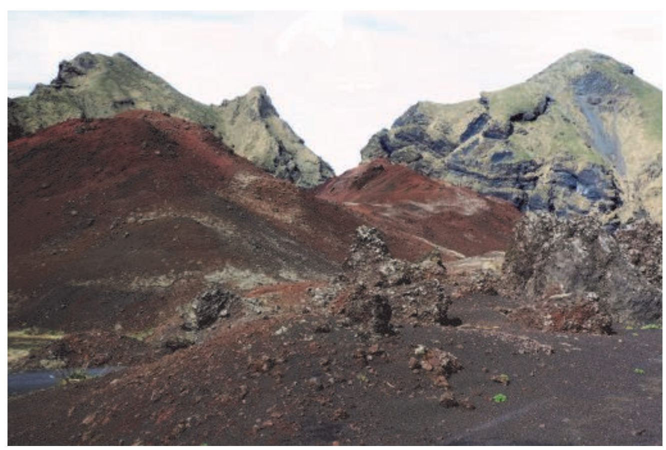
The Westman Islands are an archipelago off the south coast of Iceland, and are politically a part of Iceland. The largest island, Heimaey, has a population of just over 4,000. The other islands are uninhabited, though a few have single hunting cabins. These islands are noted for their winds, which we felt at various times while we toured Heimaey.

Our bus tour of the island included a rugged golf course, large sod houses (including the interior), volcanic crags, stone walls, many sheep, and a few hardy souls wading off a black sand beach. We also heard bits of Heimaey history, including events that began at 1:00AM on January 23, 1973:

Sod houses

The eruption of Mount Eldfell, on the east side of the island. The ground started to quake and fissures began to form. The fissures grew to a mile long, crossing the island from one shore to the other, and soon lava began to erupt. Lava sprayed into the air from the fissures in the ground. Volcanic ash was blown out to sea. Then the situation worsened, when the fissures closed and the eruption converted to a concentrated lava flow that headed toward the harbor. The winds changed, and over 600,000 cubic yards of ash were blown onto the town.

Our tour guide, who was around 12 years old at the time, related how he was awakened in the



New lava, 1973, Eldfell eruption

middle of the night by the eruption, and how he and the rest of the island's inhabitants were forced to evacuate. Fortunately, the previous day the seas had been rough, so most of the island's fishing fleet was in the harbor and available to carry evacuees. Within six hours, the entire population of 5300,

Lava edge

been recently completed. It was saved from being crushed by men shoveling the tephra from the roof. Our guide said that the tephra beside the

Heimaey, house crushed by 1973 eruption

hospital was as high as the first floor by the end of the eruption months later. Other homes were destroyed by fire caused by lava bombs.

To me, the most compelling aspect of the eruption was the plight of the harbor. Iceland itself has no good harbors on its south shore, but Heimaey had an excellent one. The island's main source of income was from fishing, exploiting the rich fish stocks in that area, and 25% of Iceland's total fishing catch came from Heimaey. The eruption threatened to completely engulf the harbor. Starting in early February, it was decided to try to slow the lava by spraying it with sea water. Early efforts were small scale, but showed the scheme might work. More Icelandic ships were brought in to pump sea water. Amazingly, a network of pipes was laid over the lava to further spread the sea water. The pipes would have melted except for the cold seawater coursing through them. These pipes were laid under extremely dangerous conditions with no major injuries or fatalities. The United States provided 32 pumps, each with a capacity of over 250 gallons per second. Overall, approximately 8 million cubic yards (6 million tons) of seawater was pumped. The effort was successful. The harbor was saved, and is now even better protected than it had been, since its entrance is now narrower.

Although the island was devastated, most of the population was eventually able to return. The eruption had severed the electric cable and water pipeline which had supplied the island from Iceland; these had to be replaced. Removal of the tephra and ash was a massive job. The island actually grew by almost one square mile, increasing its size by 20%. We drove over parts of this new land and were able to gaze down at the town below. Channels were bored into the cooling lava, and for decades after the eruption, the island extracted heat for domestic use from the lava. Currently, a few of the engulfed houses are being excavated, and the contents are remarkably well preserved and can be identified by the original owners. Near the end of our bus tour, our guide stopped briefly at a house a few blocks from the edge of the lava, and told us that was his boyhood home, which had escaped destruction.

Our flight back to Reykjavík was spectacular. We followed a circuitous route that took us over lava fields, snowfields, glaciers, braided streams of glacial meltwater, land sculpted by glacial melt, waterfalls (including a double one), and volcanic cones. We saw from the air sights that we had seen days earlier from the ground, including the mid-Atlantic rift valley at Thingvellir, the glacial snout at Sólheimajökull, and the waterfall Seljalandsfoss. This aerial tour provided the perfect finish to our exciting trip to Iceland.

If you would like to see many more photos of this trip, visit https://picasaweb.google.com/dewilhelm53 and select the Iceland albums. (There will eventually be nine.) For a map of our trip, see http://goo.gl/maps/mYCoz .

2014

International Year of Crystallography

Crystals can be found everywhere in nature. They are particularly abundant in rock formations as minerals (gemstones, graphite, etc.) but can also be found elsewhere, examples being snowflakes, ice and grains of salt. Since ancient times, scholars have been intrigued by the beauty of crystals, their symmetrical shape and variety of colors. These early crystallographers used geometry to study the shape of crystals in the natural world.

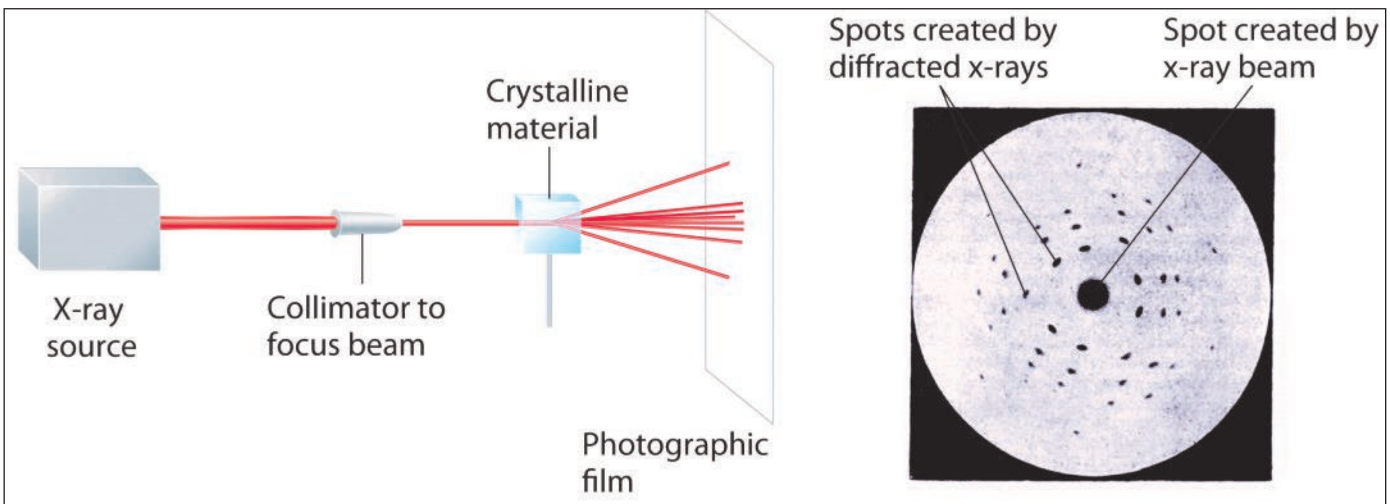
In the early 20th century, it was realized that X-rays could be used to 'see' the structure of matter in a non-intrusive manner. This marked the dawn of modern crystallography. X-rays had been discovered in 1895. When X-rays hit an object, the object's atoms scatter the beams. Crystallographers discovered that crystals, because of their regular arrangement of atoms, scattered the rays in just a few specific directions. By measuring these directions and the intensity of the scattered beams, scientists were able to produce a three-dimensional picture of the crystal's atomic structure. Crystals were found to be ideal subjects for studying the structure of matter at the atomic or molecular level, on account of three common characteristics: they are solids, three-dimensional and built from very regular and often highly symmetrical arrangements of atoms.

Thanks to X-ray crystallography, scientists can study the chemical bonds which draw one atom to another. Take graphite and diamonds, for instance. These minerals hardly look alike: one is opaque and soft (graphite is used to make pencils), whereas the other is transparent and hard. Yet graphite and diamonds are close relatives, chemically speaking, both being composed of carbon. It is the ability to disperse light – owing to the structure of its chemical bonds – which gives a diamond its 'shine'. We know this thanks to X-ray crystallography.

At first, X-ray crystallography could only be used to look at solid crystals with a regular arrangement of atoms. It could study minerals, for instance, and many other compounds, such as salt or sugar. It could also study ice but only until it melted. This is because, in a liquid, the movement of molecules made it impossible to register a scattered signal that could be interpreted. Crystallographers discovered that they could study biological materials such as proteins or DNA, by making crystals of them. This extended the scope of crystallography to biology and medicine. The discovery came at a time when the growing power of computers was making it possible to model the structure of these more complex crystals.

After 100 years of development, X-ray crystallography has become the leading technique for studying the atomic structure and related properties of materials. It is now at the center of advances in many fields of science. New crystallographic methods are still being introduced and new sources (electrons, neutrons and synchrotron light) have become available

In 1914 the Nobel Prize in Physics was awarded to Max von Laue who discovered that X-rays travelling



(a) X-ray diffraction **(b) X-ray diffraction pattern captured on photographic film**

through a crystal interacted with it and, as a result, were diffracted in particular directions, depending on the nature of the crystal. Equally important was the discovery by father and son team William Henry Bragg and William Lawrence Bragg in 1913 that X-rays could be used to determine the positions of atoms within a crystal accurately and unravel its three-dimensional structure. Known as Bragg's Law, this discovery has largely contributed to the modern development of all the natural sciences because the atomic structure governs the chemical and biological properties of matter and the crystal structure most physical properties of matter. The Bragg duo was awarded the Nobel Prize in Physics in 1915.

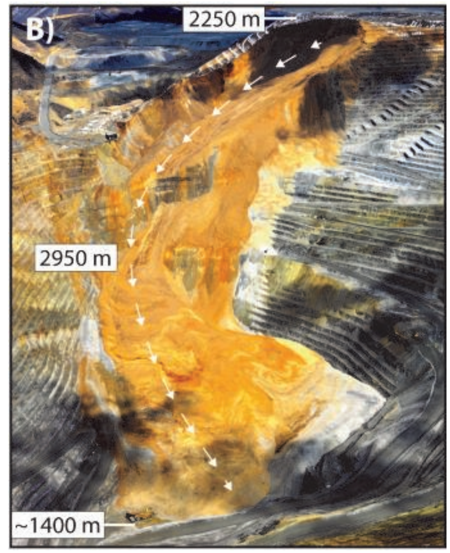
Mineralogy is arguably the oldest branch of crystallography. X-ray crystallography has been the main method of determining the atomic structure of minerals and metals since the 1920s. Virtually everything we know about rocks, geological formations and the history of the Earth is based on crystallography. Even our knowledge of meteorites comes from crystallography. This knowledge is obviously essential for mining and any industry which drills into the Earth, such as the water, oil, gas and geothermal industries. The Curiosity rover used X-ray crystallography in October 2012 to analyze soil samples on the planet Mars. NASA had equipped the rover with a diffractometer. The results suggested that the Martian soil sample was similar to the weathered basaltic soils of Hawaiian volcanoes.

Excerpted from the
International Year of Crystallography website

One aim of the Year is to promote education and public awareness through a variety of activities. To learn more about crystallography and the International Year, visit the websites of the International Union of Crystallography www.iucr.org , UNESCO www.unesco.org , and the International Year of Crystallography www.iycr2014.org

Mega-Landslide in Giant Utah Copper Mine May Have Triggered Earthquakes

Landslides are one of the most hazardous aspects of our planet, causing billions of dollars in damage and thousands of deaths each year. Most large landslides strike with little warning and limit our ability to collect important data that can be used to better understand their behavior. The 10 April 2013 collapse at Kennecott's Bingham Canyon open-pit copper mine in Utah is an important exception.



Careful and constant monitoring of the conditions of the Bingham Canyon mine identified slow ground displacement prior to the landslide. This allowed the successful evacuation of the mine area prior to the landslide and also alerted geologists at the University of Utah to enable them to successfully monitor and study this unique event.

The landslide — the largest non-volcanic landslide in the recorded history of North America — took place during two episodes of collapse, each lasting less than two minutes. During these events about 65 million cubic meters of rock — with a total mass of 165 million tons — collapsed and slid nearly 3 km (1.8 miles) into the open pit floor.

In the January 2014 issue of *GSA Today*, University of Utah geologists, led by Dr. Kristine Pankow, report the initial findings of their study of the seismic and sound-waves generated by this massive mega-landslide.

Pankow and her colleagues found that the landslide generated seismic waves that were recorded by instruments located up to 400 km from the mine. Examining the details of these seismic signals, they found that each of the two landslide events produced seismic waves equivalent to a magnitude 2 to 3 earthquake.

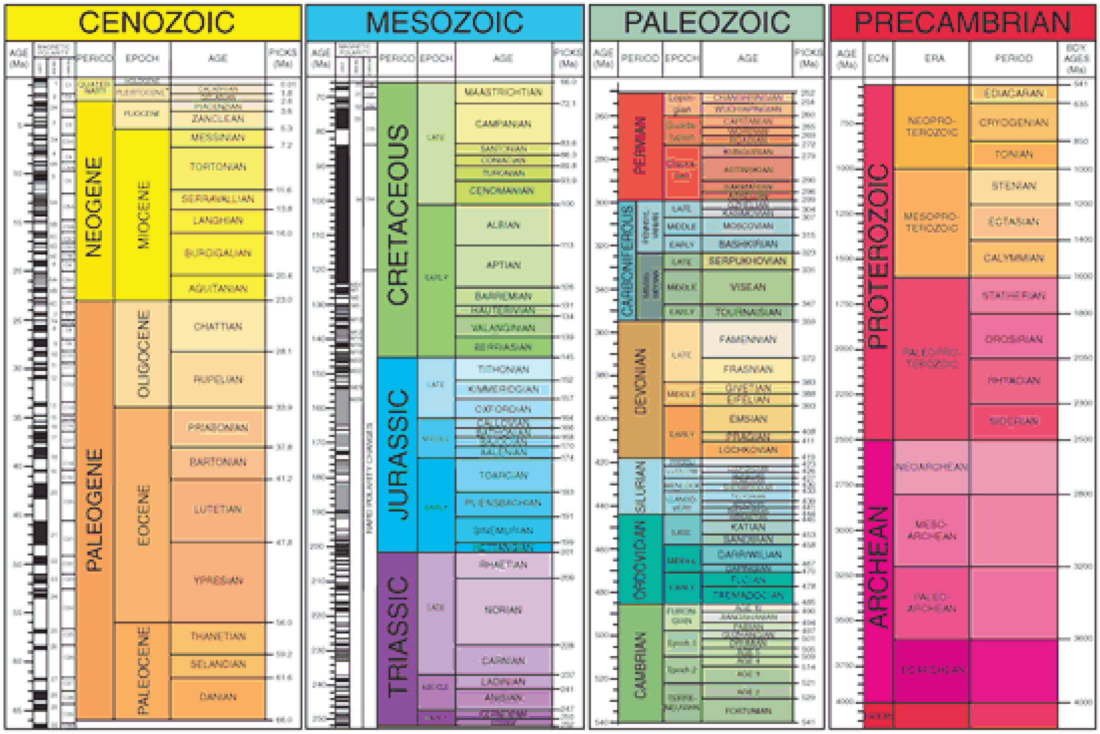
While there were no measurable seismic events prior to the start of the landslide, the team did measure up to 16 different seismic events with characteristics very much like normal "tectonic" earthquakes beneath the mine. These small (magnitude less than 2) earthquakes happened over a span of 10 days following the massive landslide and appear to be a rare case of seismic activity triggered by a landslide, rather than the more common case where an earthquake serves as the trigger to the landslide.

Later studies of both the seismic and sound waves produced by this landslide will allow Pankow and her team to characterize the failure and displacement of the landslide material in much more detail.

GSA Website

NEW GEOLOGIC TIME SCALE

The Geological Society of America (GSA) has published a new Geologic Time Scale which has undergone substantial modifications, commensurate with major advances in understanding of geologic time. The new Time Scale (18 X 27") can be purchased for $9.95 from the GSA Store online at www.geosociety.org.



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