

NRRI Mission:

Deliver research solutions to balance our economy, resources and environment for resilient communities.

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Happy New Year message from the Executive

Director:

Wow! 2017 was a big year at NRRI. The Minnesota Legislature added to its investment in the Institute and we're really excited about what's ahead in 2018.

You can expect more of what you always get from NRRI – your applied research institute – delivery of impactful solutions that make a difference to Minnesota's economy, our unique environment and our communities.

With your support and collaboration, we made significant progress in 2017. Some highlights include

- Identifying and demonstrating new, high value mineral opportunities in our state,
- Optimizing the processing of wood and wood byproducts to create new opportunities such as fuels, chemicals and other materials.
- And we are always focused on our most important natural resource – water.

NRRI is here to help Minnesota build tools to best use and protect its water and forest resources well into the future.

So yes, 2017 was a great year, but in 2018, we look forward to developing broader partnerships and taking on larger, more impactful projects.

Minnesota must be able to take bold steps to compete on today's world stage. We will continue our focus to deliver the tools and information needed to create that economy of the future.

We look forward to seeing you in the new year!

Rolf Weberg

NRRI Leadership

Rolf Weberg, Executive Director

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Iceland takes NRRI geologist back in Minnesota time



He called it a geologist's "mecca." Iceland didn't disappoint NRRI Geologist George Hudak one bit during a trip this past summer. Even more, it informed what he thinks he knows about Minnesota geology. And Hudak knows more than most.

When the Institute of Lake Superior Geologists announced the field trip to Iceland, Hudak jumped at the chance. His expertise is in submarine volcanoes and other underwater eruptions. And Iceland has that in spades. The island is the exposed part of the Mid-Atlantic

Ridge, still forming by underwater volcanic activity, with the newest formations just thousands of years old, compared to North America's billions-plus. Hudak saw Iceland's delicate textures and processes that were like a trip back in time to the forming of Minnesota's geology.

"It was an opportunity to see two tectonic plates move away from each other just as they did in Minnesota," he said. "The 1.1 billion year old mid-continent rift went right through Duluth-Superior, and geological processes in this rift formed the volcanic and sedimentary rocks along the North Shore, as well as the extensive mineralization we have today in the Duluth Complex."

He stood in amazement in Iceland's mid-Atlantic rift as it moves apart just inches per year, with the North American plate on one side and the Eurasian plate on the other.

He also saw perfectly preserved volcanic rocks that looked eerily familiar.

The area near Five Mile Lake in St. Louis County has peperite – rocks that form when there's interaction between magma and loose, wet sediments – and Iceland has tons of peperite. What gets geologists excited is that Iceland's rocks are "fresh."

"They haven't been chemically or physically weathered, they haven't been baked, and they haven't been

folded or faulted. They're just perfectly preserved," said Hudak. "When I see the same textures in Minnesota's 2.7 billion year old rocks I'm amazed and can appreciate what Mother Nature is capable of preserving over the vast expanse of geological time."

Observations of "pillow dikes" (intrusions of magma containing pillow-like structures that cross-cut the layering in the rock) in a quarry just east of Reykjavik also confirmed Hudak's mapping of pillow dikes in in Minnesota's Vermilion District. "I knew what I mapped was right, but it was awesome to see perfectly preserved modern examples. They're rare, unusual rocks, and we still don't truly understand how they form."

Viewing the geology of Iceland by Land Rover meant actually seeing how rifts and volcanoes form in real time. In Minnesota, Hudak and other NRRI geologists piece together the geology from scattered outcrops.

"There we saw everything and could really get a sense of the scale," he added. "Given our limited outcrops, it makes me wonder how many geologic treasures we don't know about in our Minnesota rocks."

NRRI gets on board for ballast technology testing

Chasing a 656-foot red ship to ports around the world might sound like fun – and it was. But the globetrotting was part of a research effort to stop the spread of aquatic invasive species as part of the Great Waters Research Collaborative.

NRRI Senior Research Associate Euan Reavie and his team of scientists delivered their final report on an effort they began years ago to test ballast treatment technologies. How well does the equipment kill off critters we don't want infesting our Great Lakes?

After a decade of lab research, this final step was to test the technology on a working commercial bulk carrier, the *MV Federal Biscay*. They analyzed the ballast water at uptake ports from Ireland to Costa Rica and discharge ports from New Orleans to Hamilton, Ontario. Nearly 20 ports with a variety of water types (fresh, marine and brackish) were visited during the year-long effort. Each port stop could last from a few days to a couple of weeks.

"These are commercial operations that weren't concerned about our schedules," Reavie said with a laugh. "The schedules would change because of bad weather or a new order to pick up. They were hauling limestone or taconite, all kinds of things."

The researchers were testing one specific, promising technology called BallastAce, a filtration and chemical injection treatment technology, made by JFE Engineering Corporation. At the intake port stops, the researchers needed a certain number of organisms present to do a valid test. The tests



MV Federal Biscay pulls into the Duluth-Superior harbor. NRRI researchers chased the ship around the world to test technologies that remove invasive species from ballast water. Photo by Kenneth Newhams, Duluth Shipping News

also had to pass five times consecutively or it wasn't valid. The final report is now in the hands of the vendor and policy makers so they can deploy the technology on ships with confidence.

"The engineers who build equipment like this have good intentions," Reavie explained. "But they don't necessarily grasp the complex biology or water around the world. A vendor may have done preliminary testing in Europe, and then come to Lake Superior and get completely different results."

Through the years, NRRI's research and work by the Great Waters

Research Collaborative has had an impact. Vendors use the information to improve their technologies, and some went off the market completely.

Now NRRI is engaged in a project specific to the Great Lakes, testing ballast discharge for invasive species that are known to wreak havoc on native biology.

"We know invasives are getting to Duluth because we see them; they're here. But we've never adequately quantified it," said Reavie. "What exactly is coming in ballast water? At what rate? How many? That's what we're figuring out now."

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