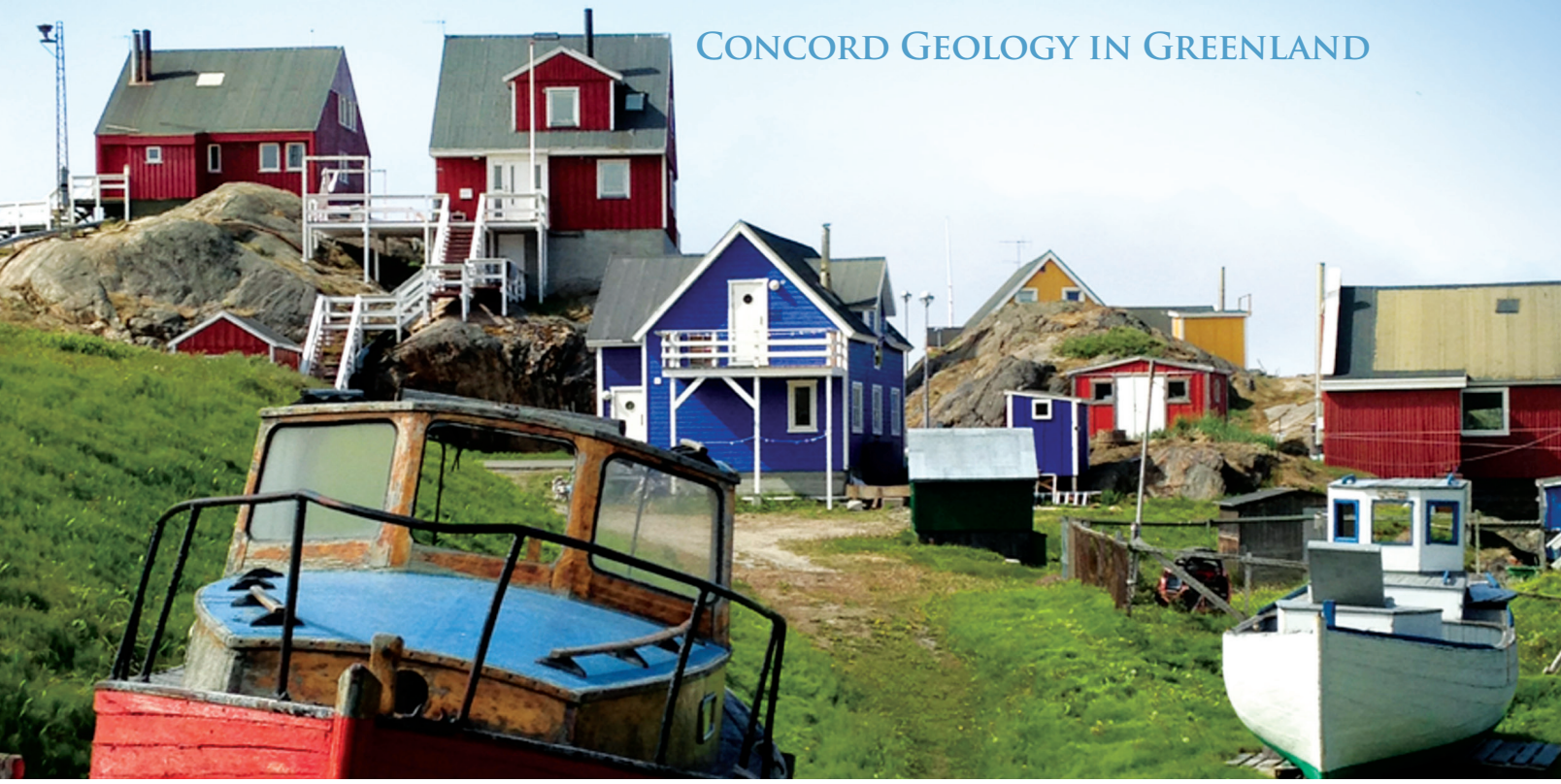
Arctic Travels

Concord Geology in Greenland



Brightly colored houses in the town of Sisimiut.

Last year in these pages, the article Volcanic Travels featured a geology research trip to the Pacific northwest with Concord students. Not to be outdone, this year two Concord geology students joined me in a field expedition to a remote site in western Greenland north of the Arctic Circle in July and August. Our work was funded by a major grant from the American Chemical Society Petroleum Research Fund. The scientific objectives of the project are to investigate how geologic faults develop through time – but more on that later.

Back here in West Virginia, most of the local community was surprised to hear that you could even go to Greenland. We fielded numerous questions, such as – Will you need to carry a rifle to avoid being eaten by polar bears or trampled by a musk ox? How will you get around on the ice and avoid falling into a crevasse? What will you eat? Do any people live there? Is it very cold? How will you get there? These are all great questions, which I have to admit that I wondered about before organizing my first expedition there in 2013 with Concord student Luke Stevens (B.S. '14, Environmental Geosciences).

Our field site is on the island of Sarfannguit, a 17-mile-long sliver of land between the Ikertooq and Amerloq fjords. The island rests at the mouth of the fjords where they empty into the Davis Strait, which connects the north Atlantic and Arctic oceans and separates Greenland from Baffin Island in northeastern Canada. Sarfannguit lies 100 miles west of the massive ice sheet that covers more than three-fourths of Greenland. Sarfannguit is a rugged island covered with squishy tundra between scattered dark outcrops of metamorphic gneiss and countless freshwater ponds that served as our source of drinking water. In many areas, the topography rises steeply from the fjords to as high as 1300 feet above sea level. There are no trees, but the scenery is wholly fantastic. An endless rolling landscape of tundra covered with brilliant splashes of green, brown, pink, yellow, blue, and purple. Although Greenland has polar bears, they stay north of our field site during the summer, and

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A final view of the town of Sisimiut as we sail south towards our field research site.

the musk ox herds are only found on the mainland near the ice cap. The wildlife we encountered included a wide variety of birds, Arctic foxes, and an occasional whale. We were engulfed in silence and free of the background din of society.

The people of Greenland are clustered into small, isolated communities. With a total population of 56,000, about 6000 fewer than here in Mercer County, West Virginia, Greenland has the distinction of being the least-densely populated country in the world. Most of the population is concentrated in and near the capitol city of Nuuk on the southwestern coast of Greenland. Our field site is farther north near Sisimiut, the second largest town in the country with a population of 5500. There are no roads connecting any of the towns or settlements in Greenland, making logistics quite a challenge. The local population travels between settlements by helicopter or boat, and in the winter by dog sledge. Our travels took us to Sisimiut via three flights on two commercial airlines, and then to the field area on Sarfannguit by boat with the assistance of a local outfitter. He left us on the island for 2 ½ weeks, where we set up a tent camp and accessed our field sites on foot. We also had a 2.5-meter zodiac with a 15 HP outboard engine, which we used to access smaller islands and skerries in the Ikertooq fjord and the Davis Strait.

Our trip began with a flight to Reykjavik, Iceland, where we transferred to a flight on Air Greenland, the only commercial airline serving the country. We had a layover between flights and spent the first night camped at Thingvellir National Park in southwestern Iceland. The site has cultural importance because it was the location of the first parliament in the western world in 930 AD. For geologists, it has scientific significance because it lies within the actively spreading volcanic rift valley of the mid-Atlantic ridge, where new seafloor is being created as the North American tectonic plate spreads westward away from the European plate. This was a remarkable experience for a

The zodiac speeds into the Ikertooq fjord skippered by a Concord geology student.

seasoned field geologist, and even more momentous for our Concord undergraduate students.

We spent the second night camped in Nuuk, Greenland, and then continued on with another flight the next day to Sisimiut where we spent the night in a guest house operated by Heli Greenland, our outfitter. From there, we travelled more than an hour by boat to our field site and settled in to accomplish our research objectives. Our daily work plan involved conducting field mapping from early morning until evening. Our evenings featured a hot camp meal cooked over a small backpacking stove. On two occasions, we dined on fresh fish – student-caught Greenlandic cod straight from the fjord. Following dinner, we split rations of chocolate. Mathew Merson (Environmental Geosciences senior) frequently led some poetry readings, typically from the works of Robert W. Service. His works were also a favorite read during the long winter months of Douglas Mawson's Australasian Antarctic Expedition just over a century earlier.

Although it was six weeks past the summer solstice, it was still light enough to read inside a tent at any hour of the night. The sun circled around us during the day, reaching a surprisingly low high point due south at noon, and barely skimming below the horizon behind mountains to the north after 11 p.m., casting a brilliant sheen of orange and purple across the northern sky for several hours, making it difficult to tell when sunset ended and sunrise began. The low sun generated only modest daytime temperatures. The Arctic summer is in fact quite cool and not unlike November in West Virginia. During the day it was typically 40–45˚F, and slightly cooler at night. But wind and morning fog could make it feel quite a bit colder, especially when we were working on the coast since the temperature of the ocean was about 34˚ F.

Our tent camp on Sarfannguit with CU students Mathew Merson and Michael Green (both Environmental Geosciences seniors).

The goal of our work is to study a huge system of interconnected faults that originally formed during earthquakes three or more miles deep. These earthquakes left behind an unusual rock type generated by intense friction that melted the ruptured earthquake fault, leaving behind thin black veins speckled with broken mineral fragments. The melting likely happened in a matter of seconds as the earthquake fault moved. Then, the molten material cooled off in a few more seconds to a few minutes leaving behind a thin black vein of rock. We do not yet know the age or exact depth under which these curious rocks formed. But the answers to these questions are part of our research objectives. The earthquake ruptures were later uplifted to the Earth's surface and eroded off by glacial ice in the recent geologic past, and they now provide a unique fossil record of earthquakes. One of our most exciting discoveries during the 2015 expedition was that the faults could be continuously traced and mapped for more than 8 miles. We expect to extend this for a much longer distance in future expeditions. Even so, this is now the second-largest fossil earthquake zone known in the world. It is at least half as long as a fault system in the Colorado Rockies that has been

The target of our study – A swirly black and green vein formed by frictional melting during an ancient earthquake rupture several miles below ground.

studied by Concord students over the past 16 years during our summer geology field course and as part of two National Science Foundation research projects at Concord.

So why is it important to study a site such as this? The friction-generated rocks are rare and only found in a few dozen locations around the world. When earthquakes rupture along the San Andreas or other active faults around the world, the hypocenter, where the rupture initiates, is typically several miles below ground. Since we can only observe the hypocenter indirectly by looking at seismograms, our field site provides a unique window into the deep part of a fault where earthquakes form. We hope to answer a variety of questions during our study. For example, how does the geology below ground influence the distribution and length of earthquake ruptures? Do the previously molten rocks tell us anything about how powerful the earthquakes were? These are critical questions that are not well known to science today. The solution to them may help us to understand how earthquakes operate, and from

Spectacular colors of the Greenland tundra, with the Ikertooq fjord in the background.

a larger perspective, how faults begin to form. The latter question is important from a resource perspective because geologic faults can control the distribution of fossil fuels and the flow of groundwater.

The value of a research expedition such as this extends to all of the students in Concord's geoscience program. Those who didn't travel will have the opportunity to conduct original research in their Concord geology classes on some of the samples we collected. Non-majors taking our general studies introductory class in geology will see the photographs, hear the tales, and become immersed in the excitement of scientific discovery. The impact is remarkable and far-reaching. For more photographs and research news, follow us on Twitter ***@CU_in_the_field*** and ***@CUGeology***.

West Virginia Geographic Alliance
Receives National Geographic Society Grant

The West Virginia Geographic Alliance, hosted by Concord University, has been awarded a grant of $32,709 from the National Geographic Society.

According to Dr. Joseph Manzo, co-coordinator of the alliance and Concord professor of geography, the grant will benefit teachers and students in the public school system as well as Concord University students.

"The money will be used to support geography in the classrooms in the form of materials, free graduate (professional development) classes and student activities," he said.

A number of professional development classes offered through Concord's Graduate Studies Program will be available to K-12 teachers thanks to the grant. Among the topics are "Learning with Maps," "Urban Geography," and "North Africa and the Middle East."

For more information visit: ***www.concord.edu/graduate/geography-alliance-courses***

The funding will also help support the annual Geography Bowl for high school students and the West Virginia Geographic Bee, a yearly competition for 4th through 8th graders. Both events have been held at Concord University in recent years.

Dr. Manzo said the grant also helps fund employment for Concord students working during these events and those who work in the office.

To learn more about the grant and the West Virginia Geographic Alliance contact Dr. Joseph Manzo at manzoj@concord.edu or 304-384-5208.

Additional information is also available at: ***http://www.wvgeographicalliance.org/***