Jocelyn Hirose, left, records information from a segment of ice drilled on Ellesmere Island, as Alison Criscitiello prepares another drill segment. ALISON CRISCITIELLO SUBMITTED

Canmore researchers drill Arctic ice cores

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It was a trip of a lifetime when Jocelyn Hirose travelled from her Canmore home to Ellesmere Island in Canada's high Arctic to drill glacial ice cores.

A Banff National Park resource conservation officer with a masters degree in glaciology, Hirose was invited by her part-time roommate, glaciologist Alison Criscitiello.

For three years Criscitiello has been principle investigator on ice core drilling projects in Canada's high Arctic. She invited Hirose as a field assistant to perform the meticulous work of processing and packaging ice cores. Camping and conducting scientific research at 82 degrees north latitude for two weeks earlier this summer was a dream trip for both.

"We just love to geek it up about ice and dream about desolate places," Hirose said. "We're both really passionate about glaciers and ice and harsh conditions. And this is a place no one easily gets permits to go to."

"What a dream for me to be able to take a close friend - but also an incredible teammate for this kind of work – into the field with me," Criscitiello added. "Jocelyn is extremely skilled when it comes to everything required for processing an ice core – understanding and reading weather, and living and working in harsh conditions."

Having Hirose's Parks Canada training include a firearm permit – necessary for working within Quttinirpaaq National Park – was helpful. Just 800 kilometres from the North Pole, the Park boasts rugged peaks, ice caps, glaciers and tundra sparsely inhabited by Arctic hare, foxes, wolves, muskoxen, Peary caribou and polar bears.

"I was the bearer of the shotgun on bear watch," Hirose said. "I had the shotgun right next to my ice core processing spot. It was pretty surreal."

Just travelling there was an adventure, flying from Calgary to Ottawa, then to Iqaluit, stopping in several communities before reaching Resolute Bay, Nunavut. From there they flew 995 km by Twin Otter, refuelling along the way (and return) at Eureka, Grise Fiord, Tanquary Fiord and Alert. They touched down at Lake Hazen to pick up collaborator Igor Lehnherr, assistant professor at University of Toronto-Mississauga, from his research site to work with them.

"When we landed at Lake Hazen to pick up Igor, a polar bear and her cub had just walked through camp," Criscitiello said. "So, I was a little worried, but we never did see any."

Before landing at their site, the Kenn Borek Air pilot flew low to test that the snowpack wouldn't collapse under the weight of the plane.

"He literally skied the icecap with his plane," Hirose described.

"Kenn Borek pilots are truly the best in the world at Arctic and Antarctic flying," Criscitiello said. "They take off in variable snow conditions, and sometimes in very tight and technical locations, which can also be extremely difficult. It's very committing when they fly away. You're really on your own."

They set up camp – small mountaineering tents for sleeping plus a large kitchen tent – then began working. Running the motorized drill was left to Criscitiello and Lehnherr in recognition of another challenge – Hirose was three months pregnant.

"The risks associated with my being pregnant had to be discussed right from the start," Hirose admitted.

Those included flying at high elevation in un-pressurized planes, but they mostly flew below 10,000 feet. Pregnant northern women, Hirose pointed out, fly in small planes for medical appointments. She didn't experience any worrying symptoms.

Another potential hazard they didn't worry much about was falling into crevasses, as the snowpack was at its seasonal maximum.

Using a single-barrel Kovacs drill, they cut the ice in one-metre segments, adding one-metre sections of pipe to the drill to retrieve the next segment. The process is repeated until the 20-metre-long drill cuts the 20th core.

"It's very physical work to operate," Criscitiello said. "There's no winch, that's why we hit a max depth with this drill. It also becomes prone to getting stuck if you attempt to drill deeper with a Kovacs, in part because the whole system has a bit of wiggle to it due to the way the one-metre pipe sections attach to one another."

Drilling one 20-metre core took one full day – in Ellesmere's 24-hour sunlight. Each metre section was packaged in long tubes of thick, flexible plastic sealed at both ends, with nine segments packaged into large insulated boxes for shipping. Criscitiello flew on a "cold deck" Twin Otter – an entire plane that's kept frozen – to Resolute. The boxes flew by commercial plane to Edmonton to be stored at the University of Alberta's Canadian Ice Core Archive, of which Criscitiello is technical director.

Natural Resources Canada funded 80 to 90 per cent of Criscitiello's Arctic projects; for the remainder she collaborates with scientists from Environment Canada's Northern Contaminants Program, which looks at mercury, plastics and flame retardants' presence and levels. Criscitiello studies paleoclimate records to reconstruct climate of past time periods, analysing the chemistry of each core to see what that location tells her. The cores taken from Ellesmere provide a record back to about 1960.

"With respect to how much time any one ice core represents, it depends on where you are, and what the accumulation rate is at that location," she explained. "On some of Ellesmere Island's icecaps, the accumulation rate can be relatively low, meaning every year is a thin slice within the core; therefore a 20-metre core goes back relatively far in time – 40 or 50 years."

On her PhD projects in West Antarctica she drilled cores hundreds of metres deep, where high accumulation rates can yield 20 years of data per 20-metre core, with high resolution.

"I'm really excited, it's so far north," Criscitiello said. "It will be interesting to see what the marine signal looks like, where it's predominantly coming from, and what environmental contaminants we find this far north."

For Hirose, the takeaway was already revealing.

"I was extremely shocked that at 82 degrees north, looking at ice cores estimated to be from the 1980s, to present crumbly layers that existed in the ice, indicating melting that far north," Hirose said.

"You lose precision when a core is broken into lots of pieces, makes it difficult to date. The high Arctic is really the place that's being impacted by climate change, and the urgency to do more coring in the high Arctic is really evident. If we wait too long we're not going to get much info."