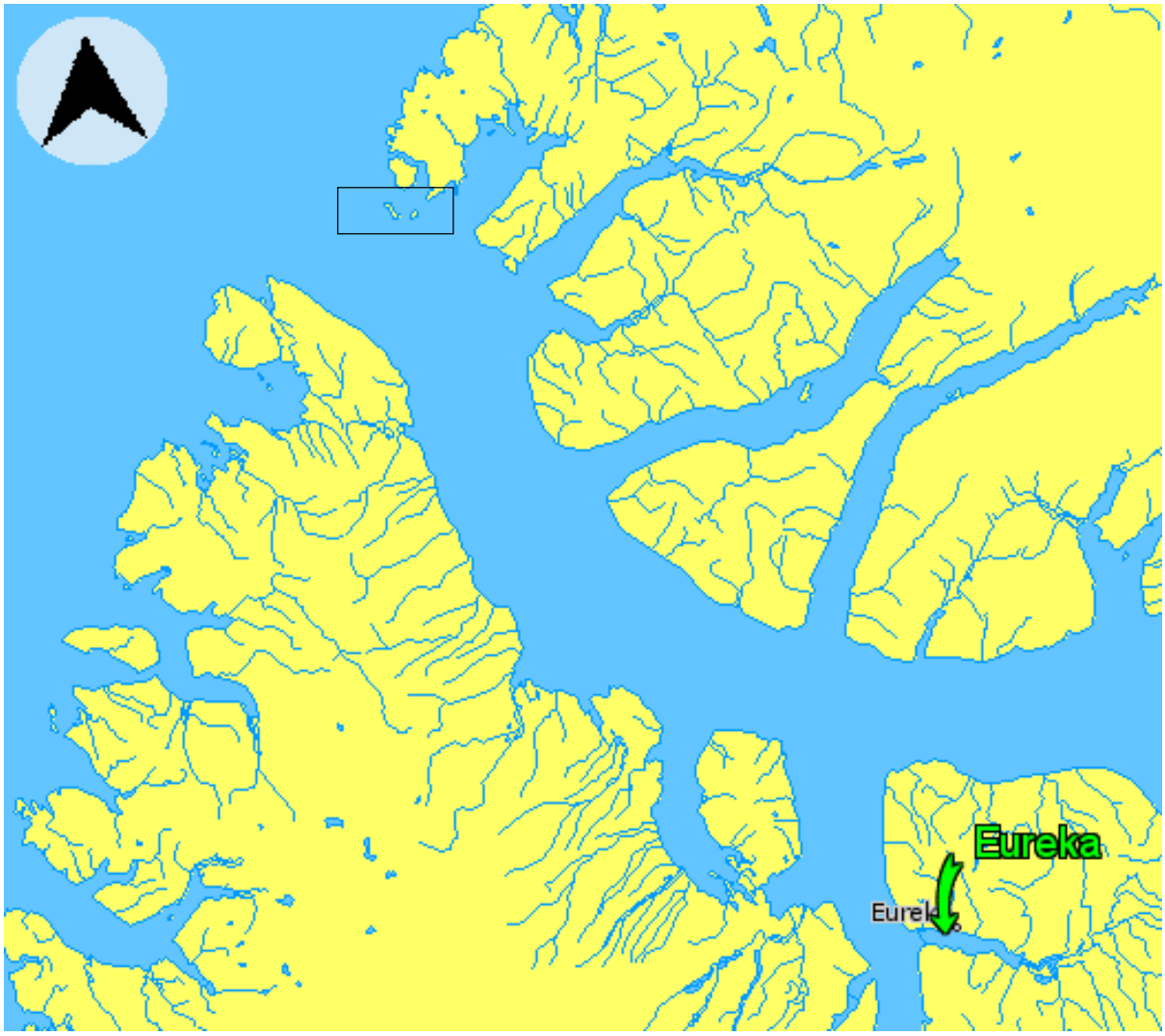
Alpha Ridge Test of Appurtenance (ARTA)

Newsletter #5

On Thursday (27 March) two more 3-component seismometers were installed. Mingzhou and I went out in one helicopter, and Thomas and Patrick took the other one. This time we anchored the recording box by digging-in two dead-men, which are really just short pieces of 2x4 with ropes attached to them. The dead-men were buried right beside the box, and the ropes were tied together, cinching the box down and preventing it from blowing away. We covered the seismometer with lots of snow both to stabilize it and to protect it from sudden temperature changes. And then we covered everything with lots of gravel. It would take a tornado to lift that baby out.

We put the box on Small Fjeldholmen Island. In the map below, Nansen Sound runs north-west from Eureka, and near the mouth of the Sound (in the box) there are two small islands, known as the Fjeldholmen Islands. The one to the east we called Small Fjeldholmen Is.



This Island was in the right general area, and, by putting the seismometer there, I could kill two birds with one stone. Many years ago we had a camp on the island consisting of three plywood buildings. At some point the camp was cleaned up, but one building was left to act as an emergency shelter for travellers, scientists and anyone else mad enough to go travelling in this countryside. The people at DRDC-Atlantic (the Defence Research Lab in Halifax where I

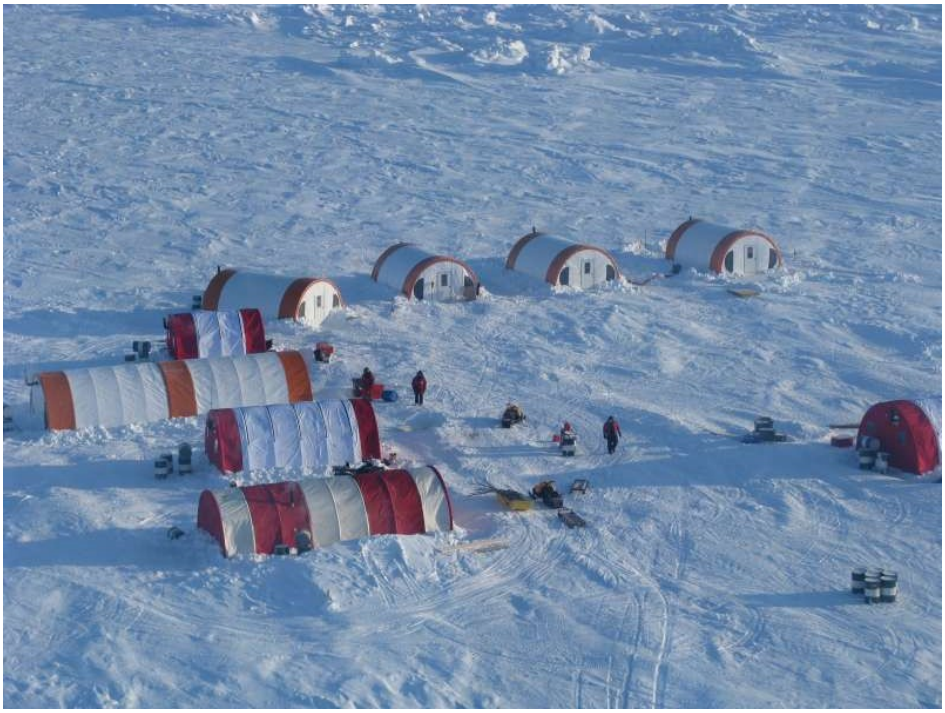
once worked) still have an interest in this camp, so I gave the building a good inspection. I opened it up and took pictures inside and out. The fuel barrel (outside) had fallen over and had been buried by snow, so I shovelled that out, and we repositioned the barrel. Inside the hut there is a heating stove and canned food. Now, if one of our helicopters, for example, were caught in the region by bad weather, the pilot could shack up (literally) and keep warm. The picture on the right was taken from the air as we left. The building is, indeed, your minimal Arctic hut; we make no claim to fine architecture. When we got back to Eureka I sent a short picture report to Garry and Jim at DRDC.

Meanwhile Thomas and Patrick installed their seismometer on Cape Stallworthy, which is on the other side of Nansen Sound. They also claim a successful installation.

Speaking of Nansen Sound, those people who once had an interest in the area will be interested to know that all the 'plug' ice has gone. The mouth of Nansen Sound used to be filled with ice that never left and very seldom even shuffled around. The mouth of the Sound was 'plugged'. The ice was held in place much like the filling in your tooth is held from moving. A small amount of the surface ice (30 to 50 cm) would melt during the summer, and the water would run down cracks. During the following winter an equal amount of ice would form on the bottom of the plug. The ice's equilibrium thickness, which it attained after many years, was about 6 metres. This 'permanent' plug formation was interesting enough that a number of papers were written about it. Now it's all gone. Everywhere I looked I could see nothing but first and second-year ice. Another casualty of global warming?

On Friday (28 March) six people in three helicopters (plus pilots) went out to the Hydrographic Camp to set-up a short seismic run. As mentioned before, the small size was to give us practice and to help us find the bugs in our procedure. However, we do expect the data to be useful. The people were: John Shimeld, Tim Cartwright, Patrick Potter, Lloyd Litwin, Thomas Funck and Ron Verrall. We picked up two blasters who were already out at the camp: Bob Olsen and Kirby Klieter.

The picture to the right shows our first view of the camp as we flew in. We're calling it the Hydrographic Camp since the people building it are hydrographic types, but of course it will also be used by the seismic workers once we get started in earnest.



We got off the helicopter to be met by 39 below and a nasty breeze. Tim and Patrick both got a slight frost-nip on their noses as they walked in from the helicopter. I put on my parka in order to protect my cheek – which now freezes very easily. I even put on my big mitts, which I haven't worn for years.

The two cooks, Joanna Edwards and Tammy Stinson, are now at the camp. As expected, we found them busy working in the cook tent, and they were surrounded by a gang of guys installing shelves, putting up groceries and hooking up another cook stove. I do believe that everyone considers the cooks a god-send. The workers had been eating their own 'cooking' for about ten days. Cooling on a rack there was a large apple pie, which gave the tent a most delightful smell. It was in a large square pan, so they called it a pie for mathematicians. (Pie are squared.) …Sorry…

Several of us tried to give the cooks a hand. We brought in snow for water, and Thomas helped them peel apples for the pie. Poor Thomas: the knife was very sharp. See the white thumb in the picture. He says it doesn't hurt. I can just hear the techs saying, "You have to be careful to keep those scientists away from anything sharp or pointy".

The small Bobcat with the snow blower on its front worked quite steadily at lengthening the airstrip. The whole camp is on a lovely large piece of smooth annual ice, and I saw no cracks. The runway will be great once the snow gets cleared off. The picture (below) shows its present state.

But, back to the job at hand. We were out there to do a short seismic run and to train those who hadn't seen this procedure before. The first job was to deploy the explosives under the ice. Patrick and I went out with the Bell 407 and thirty boxes of explosive. My job was to find

ice that was thin enough to drill through easily, and I must say that it wasn't easy. It looked as if the ice hadn't moved for a long time, so there were no patches of thin refrozen ice. Everything had been freezing for months and months. One of my jobs is to be the 'ice expert', and I earned my money that day. The three spots I did find had ice ranging in thickness from five to seven feet: not bad, but not great. At each location we left ten boxes of explosive (175 kg), a box of prima-cord, a roll of rope and a length of wood from which the explosives were supported. Following us were the two other helicopters with the people who installed the explosive.

They first drilled a 10-inch-diameter hole through the ice with a power auger. Then they laid the ten explosive cylinders end-to-end and passed the rope through a hole in the centre of each cylinder. The prima-cord was then fed down through another hole in the charge. When everything was ready, they fed the cylinders down the hole, lowered the whole thing to 100 m and tied off the rope on the stick of wood. This completed the job, and the crew went off to the next site. Later, when they wish to blow the explosives, the blasters will return and attach a detonator to the prima-cord that is sticking out of the ice. They will then pay out an electrical cable so that they can fire the detonator from a good safe distance. When they are ready to shoot, they will connect the electrical wires to a firing box. We want to know exactly when the shot goes off, so they use the timing that is available these days from the GPS satellites. The firing box synchronizes itself to the GPS clock, and it fires the detonator at exactly the top of the minute. The detonator causes the prima-cord to explode, and the prima-cord, which passes through the centre of all the big charges sets them off.

Many people ask whether it is safe to be on the ice when big explosives are going off. The short answer to that is 'yes'. The ice is very tough and resilient. No-one of our crew has ever seen a crack generated in the ice as a result of an underwater explosion. Occasionally, a block of ice perched precariously on the top of an ice ridge will roll off, but that's as bad as it gets. You do, of course, feel the shock wave as it hammers you feet, and you can hear the sound as it bounces up and down between the bottom and the ice surface.

The purpose of all this is to send acoustic energy down into the earth's crust so that we can look at the reflections from the various layers. With an explosion this big, the seismologists can 'see' right down to the mantle. The obvious next question is, 'just how do they detect or 'see' these reflections?'

They do this by placing seismometers on the ice every 1500 m, or so, along the line of the explosives. For the longer runs, some 100 to 120 seismometers will be set out. For this shorter run, only 30 units were placed on the ice. The picture at the right shows Mingzhou holding a seismometer. It is transported this way up, but it is turned over when it is placed on the ice. Basically, the little can contains a magnet and a coil of wire, one of them being fixed to the can and the other being supported on a spring. When the earth shakes, the two of them move relative to one another, and this produces a voltage, which is amplified and recorded. You can see the red cable leading back to the black box. This box contains the recording unit and batteries. Since the recorder works only to minus 20 C, the box is well insulated, and the recorder is surrounded by hot packs to help keep it warm. There is no need to keep the seismometer warm.

In the bad old days the available recording media did not allow for long records. Only short stretches of data (say, about 15 minutes) could be recorded at any one time. This meant that all the recorders had to turn themselves on automatically – and simultaneously – and the explosives had to be detonated during that short 'window' of opportunity. If the weather were bad and helicopter couldn't get to the shot sites, all the recording boxes had to be refurbished and reset. Nowadays, when enormous amounts of memory is available and cheap (1 gigabyte is considered small), the recorders can be turned on and let run for several weeks at a time. The shots can be detonated whenever the weather allows.

By the time our 30 boxes were deployed, the day was about over, and we had to hustle back to Eureka, a two-hour trip. The explosives will be detonated today (the 29th), and the boxes will all be recovered. This is a psychologically important moment, for we will have 'data in the can', and all the effort, the money and the build-up will be seen to be paying off. Two helicopters are off to the ice camp as I write this. Stay tuned for the end of this chapter.

Another minor casualty I should mention is our easy access to email. According to the powers-that-be, too much bandwidth was being used – by people downloading large files, they say – and the easiest way to cure this was to give net access to only a few people. Now our emails all have to go through Ruth's computer. I figure that if she wants to get any work done, she's going to have to carry a big stick. I'm sure we can all work around this, but email replies won't be quite so snappy. Best Wishes. Ron Verrall

We'd like to hear from you. Send your comments to: ronverrall@gmail.com

PS. The original Newsletter did not have the map showing the Fjeldholmen Islands. I have added it for the version that went on the website.