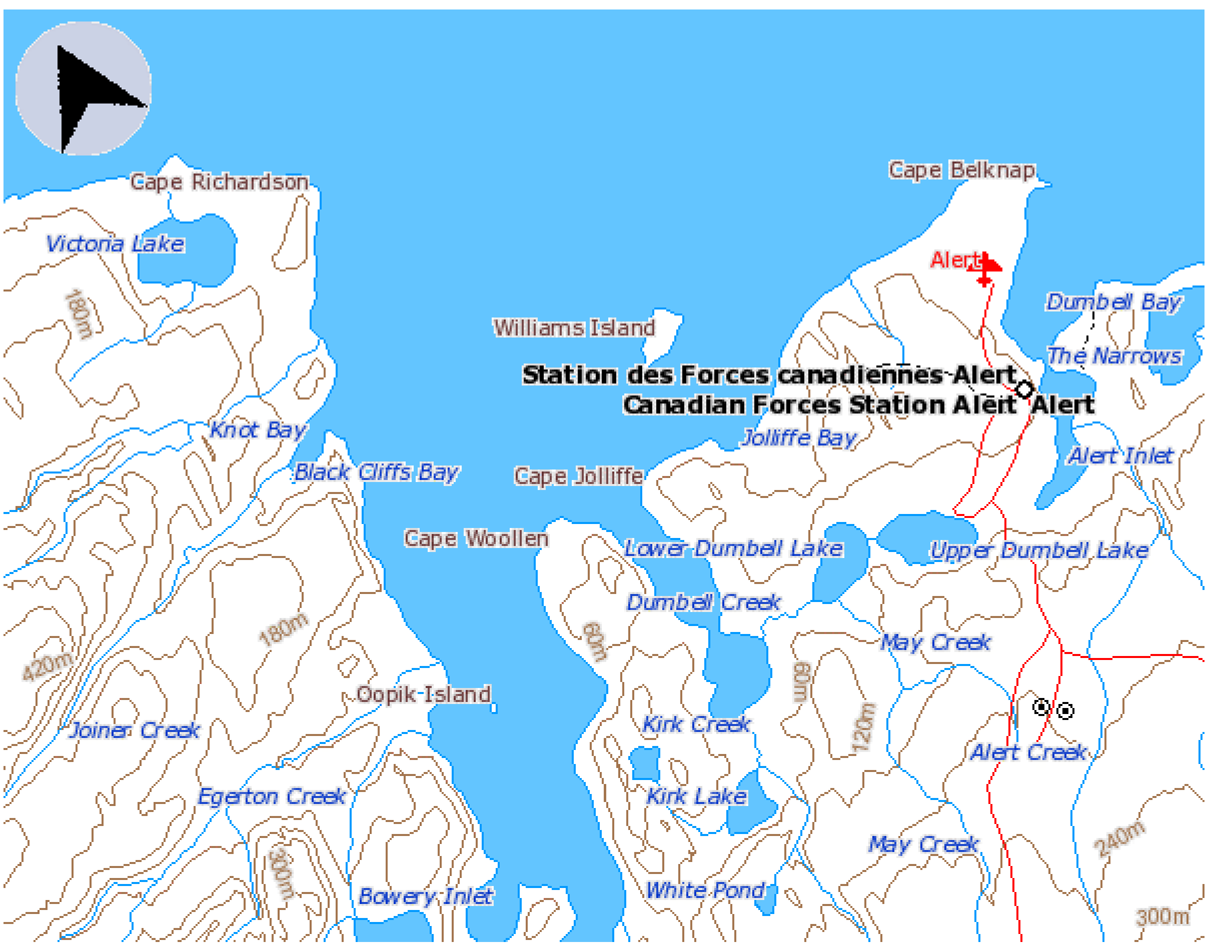
Project Cornerstone

Newsletter #2:

22 March, after supper.
The first Newsletter left us twiddling our thumbs and waiting for better weather. However, doing nothing was not popular, especially with the newbies. They were thoroughly hyped. They had been looking forward to (and fearing) this alien climate for so long that they couldn't stand being cooped up. They wandered up and down the halls discussing just what they should wear when they went outside. The weather cleared at about the same time we were having lunch, so just after we ate, everyone was taken down to the Spinnaker Building at the head of the runway. The new people were given instructions and some practice on driving skidoos while Garry Heard and I went off to the west looking for a suitable piece of ice. I gather that all the new skidoo riders had a good time. Nobody fell off or froze any important parts. However, I don't know their details, and I do know what Garry and I did, so I'll concentrate on our adventures.

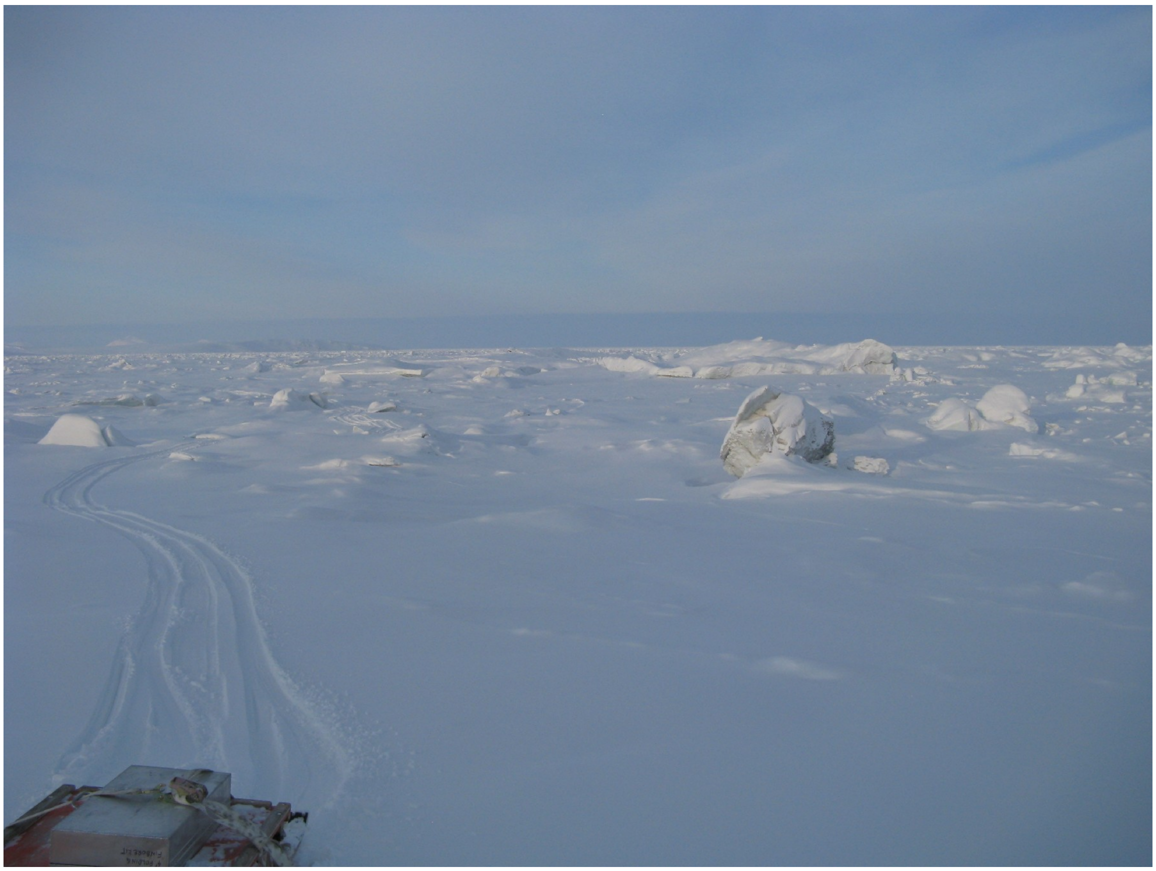
The following map (from http://atlas.nrcan.gc.ca/site/english/maps/topo/map) is intended to give you an idea of the geography around Alert. The station (where everyone lives and works) is at the little diamond called 'Alert'. The red airplane marks the southern position of the airstrip. The runway runs parallel to the coast almost up to Cape Belknap. The red line running from Alert to the airstrip is the road – the only road that is faithfully cleared during the snowy period. The other red lines are summer roads. You can gauge the scale from the fact that the straight-line distance from the point marking Alert to the cliffs beside Black Cliffs Bay is about 11 km.



Dumbell Bay, just to the east of the runway is the location of this year's major test, and I will have lots to say about this experiment in due time. (By the way, don't confuse Dumbell Bay with the Dumbell lakes.)

Garry and I went up the hill to the west until we were at a high point overlooking Williams Island. We wanted to have a good look at the ice stretching off to the north and the west. Also, a VHF radio repeater had been placed there by Al Tremblay and company a few days earlier. It was there to assist communications between the Spinnaker Building at the air strip and Garry's proposed camp out on the ice. Since we are now in Alert and have need of the repeater, we turned it on.

The ice, as far as we could see from our vantage point, looked awful. It looked like crushed lumps of ice overlain with a smoothing of snow. After swearing a little, we headed down the hill to the west and hit the ocean at roughly the spot marked 'Jolliffe Bay' on the map. Then we headed toward the small cape north of Knot's Bay. It is in that general area – over against the western side – that the water is nice and deep for Garry's experiments. We were hoping to find a fairly large piece of smooth ice for the camp and the experiments.



It was not to be. The ice was indeed horrible. It was crushed up annual ice – a rubble pile, and it was only because of the thick layer of snow that we were able to get through. The picture above gives an idea of what it looked like. The only smooth ice we came across was an old pan of multi-year ice. It had been able to withstand the ice pressure that had turned everything else into mush. However, an old pan is too thick for our purposes. We had to ignore it. By mid-afternoon it was pretty obvious that we weren't going to find anything suitable, and I was worried about losing the light. If the shadows disappeared and the lighting became 'flat', we would have great difficulty picking our way through the rubble ice.

So, with tail firmly tucked between our legs, we made our way back home and reported our failure. We contemplated going out again the next day and having a better look, but both of us were pretty sure it was hopeless. Then Richard Pederson suggest that we look in Dumbell Bay – a little north of where the first tent/experiment lies. The water was not nearly as deep there, but we had the feeling that beggars can't be choosers.

We went out about two kilometres and stumbled across a lovely large smooth pan about 2.7 km in length and about 1 m thick. (See the picture on the right.) Unfortunately, the water was only 50 m deep, which is quite a bit less that Garry had hoped for. 'Well', we thought, 'it is probably better than nothing.' Before leaving the site Garry circumnavigated the pan with his GPS running and got a 'bread-crumb' trail defining the area of good ice. When we got back he plotted up this track and discovered that the pan is sitting over water that is marked on the map as being 170 m deep. This, now, is very promising. It looks as though we have excellent ice with adequate water depth. Worried frowns have changed to broad smiles.

After supper Garry took out all the new people to give them some experience driving a skidoo through mildly rough ice. Garry said they did fine; they were slow, but that was o be expected. They were also instructed in the mysterious ways of drilling ice holes (without getting their feet wet; without losing the drill and without letting the drill freeze up before they took it apart).

What we are trying to do.
One of the most important measurement for the UNCLOS entitlement formulae is that of bathymetry (or water depth). In particular, it is important to be able to determine the 'Foot of the Slope' and the 2500-m depth contour. Over the years there have been a number of bathymetric surveys in Arctic waters. Also, the United States and the United Kingdom have released some of the bathymetry measured by their submarines. But, by no means have we adequately covered the whole area of interest. During the last few years, the Canadian Hydrographic Service, lead by Jon Bigger, has been trying to fill in many of the gaps. This year they are working north of Ward Hunt Island (a small island at the very north coast of Ellesmere Island).

Canada's UNCLOS continental shelf program is described generally on the Department of Foreign Affair and International Trade's website:
http://www.international.gc.ca/continental/index.aspx?lang=eng
http://www.international.gc.ca/continental/index.aspx?lang=fra&redirect=true

And more information as to the areas that have been covered can be found on the website:
http://pac.chs.gc.ca/files/session_2A/2A-4_MacDougall_et_al_PPT.pdf

Our intention is that in 2010 we will measure bathymetry by using two Autonomous Underwater Vehicle's (AUV). If everything goes well, these small submarines will be sent off under the ice to a point anywhere from 100 to 400 km away from the launch point. During its voyage the AUV will measure the water depth every few seconds, and it will record this depth and its location. The vehicle will then swim off to the left or right some 20 or 30 miles, so that when it returns to the launch site it will be measuring along another track. I must emphasize that it will do all this autonomously. There is no pilot. If this works well, the vehicle will be able to gather large amounts of data. Moreover, once it is on its way, it will be immune to bad weather and bad ice conditions – the bane of traditional data gathering.

The basic question is, "Will it work? How does it work? How does it know where it is?" (Actually, that's more than one question.) It will navigate by dead reckoning. In other words, it will know its latitude and longitude when it starts, and it will be able to measure its velocity over the bottom. Thus it will be able to maintain a continuous record of where it is. The next question, of course, is "how on earth does it know its velocity over the bottom?" Well, it knows the direction it is pointing because it has a compass – not a magnetic compass, but a self aligning fibre-optic gyroscope that can automatically align itself to true north. Secondly, it measures its speed over the bottom – both in the forward direction and laterally by means of Doppler sonar. It flies close to the bottom (about 60 to 100 m) and bounces the (acoustic) sonar beams off the bottom. Because the vehicle is moving, the frequency of the reflected pulse will be a little different than the outgoing pulse. This frequency difference is a measure of the speed in 'that' direction. Four such beams allow it to figure out both components of its velocity. This 'Doppler' stuff is the same principle that a policeman uses to measure your speed with Doppler radar – just before he pulls you over.

To determine the water depth the vehicle will add together two measured numbers: its depth and its height off the bottom. The depth will be determined from the measured water pressure, and the height of the bottom will be measured acoustically with a sonar beam. All this information will be stored on board.

We don't intend on sending the vehicle off on a mission this year. We don't even have the AUV that we're going to use. We have leased one from Memorial University of Newfoundland (MUN) in order to test out the various systems and to learn how to handle it in the Arctic. International Submarine Engineering (ISE) of Port Coquitlam is presently building two vehicles for our particular use in 2010 and 2011. The picture shown here is an artist's version. There will be real pictures and more details in subsequent newsletters. You can find out more by Googling AUV Explorer.

Best Wishes, Ron Verrall (ronverrall@gmail.com)