

# THE NORTHERN ENGINEER



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(for "Ice Conditions on Alaska's Beaufort Sea Coast")

## COVER

For years some people have been convinced that one day Air Cushion Vehicles would take over Alaska, as our cover seems to suggest, but that day has not arrived — yet. If Bob Thomas' views prevail, however, ACVs may soon play an important role in northern coastal communities. He presents those views and the evidence for them beginning on p. 12 of this issue. (Cover design after Department of Transportation/Public Facilities original; ACV photo courtesy of Bell Aerospace Textron; composite rendered by Evelyn Trabant, Geophysical Institute Photographic Services.)

THE NORTHERN ENGINEER is a quarterly publication of the Geophysical Institute, University of Alaska - Dr. Juan G. Roederer, Director. It focuses on engineering practice and technological developments in cold regions, but in the broadest sense. We will consider articles stemming from the physical, biological and behavioral sciences, also views and comments having a social or political thrust, so long as the viewpoint relates to technical problems of northern habitation, commerce, development or the environment. Contributions from other polar nations are welcome. We are pleased to include book reviews on appropriate subjects, and announcements of forthcoming meetings of interest to northern communities. "Letters to the Editor" will be published if of general interest; these should not exceed 300 words. Subscription rates for *THE NORTHERN ENGINEER* are \$10 for one year, \$15 for two years, and \$35 for five years. Some back issues are available for \$2.50 each. Address all correspondence to THE EDITOR, THE NORTHERN ENGINEER, GEOPHYSICAL INSTITUTE, UNIVERSITY OF ALASKA, FAIRBANKS, ALASKA 99701, U.S.A.



# ICE CONDITIONS ON ALASKA'S BEAUFORT SEA COAST: Extending the Observations\*

Sea ice can help or hinder offshore petroleum operations, depending on the conditions; because of the proposed offshore oil activity in the Beaufort Sea, there is great interest in ice conditions and motions along the arctic coast.

The coastal ice along the Beaufort Sea coast of Alaska has been under intense observation since the Prudhoe Bay oil discovery ten years ago. The decisions that must be made in the very near future on the procedures for exploration and development on the continental shelf beneath the Beaufort Sea will be based in part on the available information on the probable extent and location of potential major ice movements. Perhaps over the last several years we have seen the most severe conditions likely to be encountered during oil exploration, development, and production in the area, but given the local storms, severe weather, and variable ice, ten years appears to be a very limited sample.

## LOOKING BACK

The further we can extend our observations in time, the more certain we can be that we have enough data to be confident in our understanding, and thus our predictions, of ice events. If there were 50 years for more observations before the lease sale and activity began in the Beaufort Sea, we would not have as many uncertainties to worry about. But we do not have those years before petroleum operations begin.

What we do have is a window into the past. The permanent residents of the North Slope have been observing ice conditions

there for many years. Among the Inupiaq (or Northern Eskimo) residents are people who have been actively hunting and trapping on the ice for years. Their livelihoods and often their lives have depended on their capacity to observe and understand the ice, but very little of their knowledge has yet been written down. We have attempted to sample this knowledge through a series of interviews.

Oral histories often contain elements of myth, and that complicates interpretation — though it need not make factual interpretation impossible. As an example, the *Iliad* is believed to be (or to be based on) very old Greek oral traditions that were not recorded in written form until between the 9th and 7th centuries B.C. Because of the epic's mythical content, most European scholars dismissed the possibility of its having any historical validity and even denied the existence of Troy. Heinrich Schliemann did not agree with that view, and around 1870 his archaeological investigations revealed that Troy had indeed existed in Asia Minor at approximately the location described in the *Iliad*.

This illustrates that it can be a mistake to disregard oral traditions. They contain fact as well as myth and the fact can be a guide to future successful investigations, as in Schliemann's case. We were aware of the problem of separating myth from fact before we began our study, and did not feel equipped to handle the older traditions that were most likely to contain mythic elements. Therefore we limited our considerations to eyewitness accounts of events that the eight persons between the ages of 55 and 85 whom we inter-

viewed had seen in their own lifetimes. This sidestepped the problem of myth but limited the scope of our investigations to the last 60 years. It also restricted our sample observations of the coast, for although most hunters traveled extensively and lived in different places in different years, they could not be everywhere at once. Thus our sample is spotty and we only get glimpses of what ice conditions were like at a given location, depending on when the person interviewed happened to be there.

## PROBLEMS

There are several difficulties associated with programs of interviewing like ours. One is that it is impolite in Eskimo society to go into someone's house and ask many questions. North Slope people are becoming somewhat accustomed to questioning, because anthropologists and Federal and State agencies have been doing it for years, but it still carries a negative connotation. Related to this is a lack of feedback to the community: information goes out but the participants never see a finished product, unless perhaps in the form of a paperback book about their region from which they receive no royalties.

That brings us to the second difficulty, which is a legal one. Under the new copyright law, materials such as oral histories collected after 1910 belong to the originators, i.e., the people interviewed. There has been no court case to date involving this aspect of law, but the implication is that one needs permission from the people interviewed to distribute the material, and that they are entitled to royalties

\*See also Author's Note, p. 35.

from any published work that uses their materials and makes a profit.

The third difficulty is that the people interviewed are often very articulate in Inupiaq but not in English. The interviews must be conducted in Inupiaq and recorded on tapes which are then translated into English. This requires that the person conducting the interviews be fluent in both English and Inupiaq, understand the type of information we are seeking, and be able to pursue a line of questioning should something of particular interest come up during the interview. The quality of the information depends as much on the skill of the interviewer as it does on the knowledge of the person interviewed.

The fourth problem with interviews of this sort is logistics. There are seven North Slope villages; they are widely scattered and can be reached only by air, snow machine, or boat. The villages other than Barrow have only one telephone. Residents are fairly settled now, but at one time they traveled extensively over the area. Thus a hunter who knows about Flaxman Island may presently live in Anaktuvuk Pass. The people still do a great deal of hunting, and may be away for weeks at a time in pursuit of caribou or ducks or in fish camp, depending on the season and the game movements; when game is in the area, hunting takes precedence over everything else. It is difficult to let them know you are coming and if you arrive at the wrong time no one will be at home. That proves true for translators and interviewers as well, and there are times when it is impossible to find anyone working on your project. The whole situation can be extremely frustrating to someone thinking in terms of urban schedules with firm deadlines and regular working hours between 8 a.m. and 5 p.m.

The final problem is related to a duty owed the future. The tapes should be copied and archived because they often contain information of historical and cultural interest that may be of use to other investigators. Our translations concentrate on the information related to ice and usually paraphrase information in other areas; the people who were interviewed are growing older, and as they pass away the tapes become irreplaceable.

## METHODS

To overcome the first three difficulties we tried to get assistance from local people and agencies in doing the interviews. We contacted Kenneth Toovak, a lifetime resident of Barrow who worked at the Naval Arctic Research Laboratory for 19 years and is used to working with scientists. He speaks both English and Inupiaq, is a hunter himself, and is familiar with sea ice conditions. He agreed to conduct some of the interviews for us. We also contacted Molly Pederson of the North Slope Borough Inupiaq Language Commission, who agreed to do some of the translating and also arrange interviews for us. We gave them a list of questions and discussed the sort of information we wanted.

Since we were cooperating with the Borough we made the same financial arrangements that they use for their own interviews. The interviewer/translator is paid a consulting fee and the person interviewed is paid an hourly rate for his time and information. (Each of the eight interviews took one hour or less.) Thus, inadvertently we dealt with the legal issue by following North Slope Borough policy.

This procedure may not work in other areas. For instance, in the lower Kuskokwim and Yukon region, people are offended to be offered money. The acceptable method of repayment there is to send gifts that the persons being interviewed (or their households) need, via the interviewer or translator. (In a very different situation, Eliot Wigginton, editor of the *Foxfire* book series, pays the people his high school classes interview with as many copies of the transcript, tapes, published books, and pictures as they want; he also buys anything they make for the interview at double the estimated fair market price. In return he has them sign a legal release.) So the procedures that work in Bethel and Barrow (and North Carolina) are all slightly different, and the method chosen must be tailored to fit the local conditions.

The best way to provide feedback seemed to us to be by taking the completed transcript to the interviewed person's house and having the translator explain what the finished product said. This showed the participants that something had come of their effort and also helped

catch mistakes in translation that had been missed. We later presented each of them a copy of the finished final report.

We tried various methods to acquire and translate tapes. Self-dictated tapes proved to be least useful, while directed interviews brought out the most information about ice. These directed sessions were arranged a week in advance by the person conducting the interview, so the person contacted would have time to think about what he wanted to say.

We found that it was not completely effective for the translator to translate a whole interview at once. It proved to be faster and more informative to have the translator listen to the interview in segments and tell us what was said; if something was not clear we could ask questions at that point. This could all be done in English and recorded on another tape, which a typist could then easily transcribe.

We soon learned that it is also a good idea to have the person who conducted the interview involved in the translation process. It is very easy to lose information in the translation from Inupiaq to English, as for example, when the translator attempts to use a single term in English to express an Inupiaq term that may require a few sentences to be explained clearly. One example of such an error that arose during the translation of Bruce Nukapigak's interview was:

"The ice between those islands is controlled by the ocean."

Re-examination of the tapes showed that information had been lost in translation. A more accurate translation was:

"The ice between those islands is controlled by tidal currents that flow in and out through the channel."

Most of the sense of the statement had been lost with the original phrasing.

English idioms used by the Inupiaq people can also lead to misunderstandings. For example, North Slope people think of *seaward* as *downward*; they go "down to the sea." When they spoke of ice seaward of the barrier islands they used a phrase which translated as "ice below the barrier islands." This was perfectly clear to the translator, but not to us. As map-oriented people, we interpreted this to mean ice southward of the islands, on their inshore side. Fortunately we discussed an ice-piling



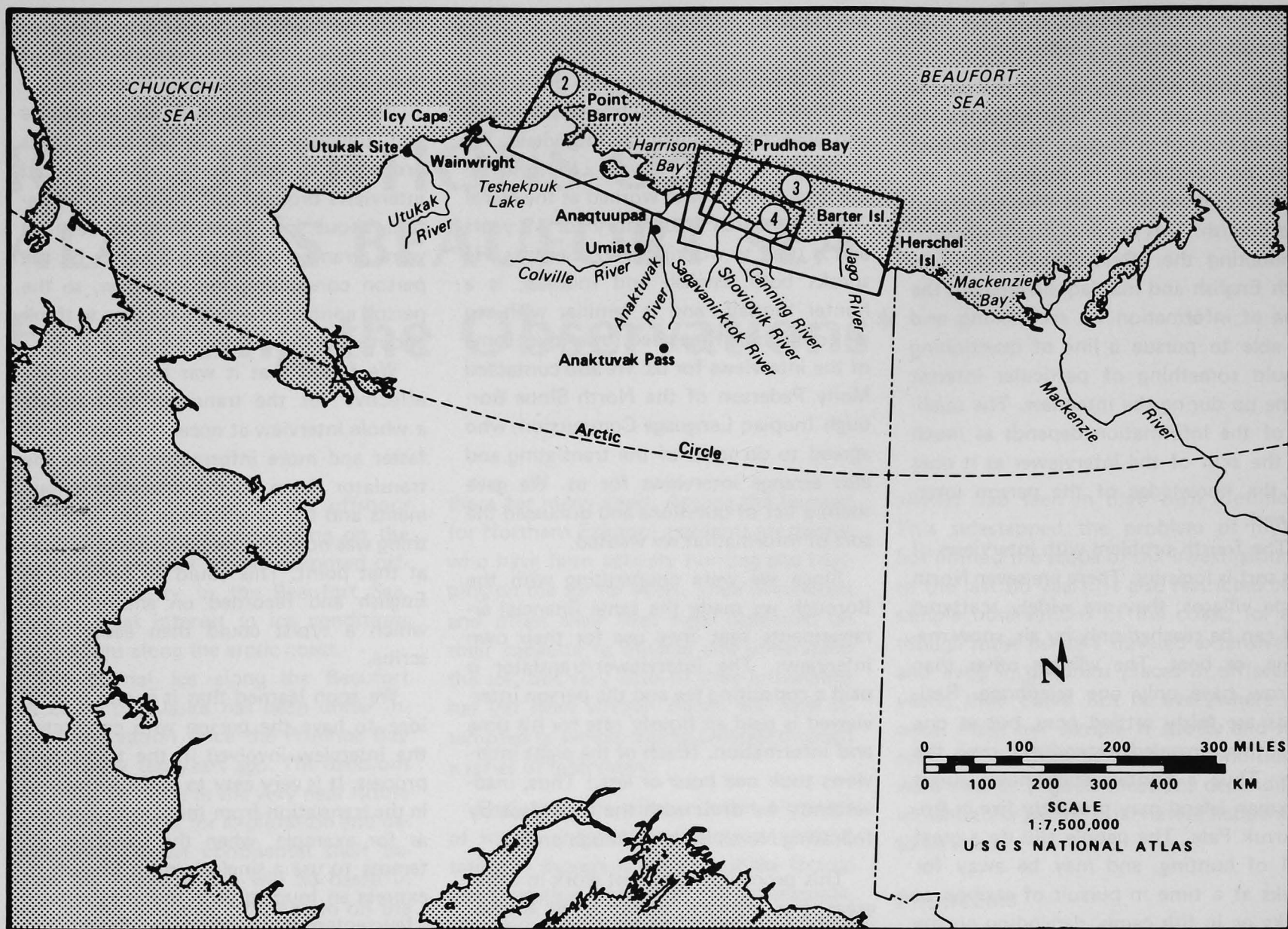


Figure 1. Map showing the region and location of the three insert maps (from the National Atlas prepared by the U.S.G.S.).

event "below the islands" with the translator and discovered the error, and the phrase has been written as "seaward of the barrier islands" throughout the final report.

Overcoming the logistics problem required patience and an adequate travel budget. We tried to minimize the difficulties by attempting to do interviews and translations only during the times between hunting seasons, and we soon learned that the project could not be conducted indirectly by phone from Fairbanks. Someone had to be able to spend periods of a week at a time in Barrow managing the operation, and we had to be prepared to send the interviewer back to ask clarifying questions, even if that meant a return trip to one of the smaller villages.

To preserve the material for future researchers, we copied tapes by means of the cassette duplicating machine in the University of Alaska's Media Services de-

partment. The duplicates were then stored in the Geophysical Institute archives.

We have gone into some detail about the interview method and how we used it because it is not a research tool often used by physicists, geologists, or engineers.

## RESULTS

Some of the points most relevant to outer continental shelf problems that were made during the interviews are summarized below. Figure 1 shows the North Slope area with the location of the following detailed maps of sections of the coast discussed by the people we interviewed.

One of the people who agreed to help us was Mr. Harold Itta, who was 71 years old when we interviewed him. He had been born in Barrow but had lived on the coast at Esook near Cape Halkett for a number of years. The following paragraph

from the transcript of his interview, though it contained information that was especially interesting to us, is typical. Parenthetical comments are additions by the interviewer after he clarified points with Mr. Itta.

"I remember there was quite a lot of huge grounded polar ice in the summer of 1930 in front of Esook, about three miles out. It never did melt all summer. It was still there when the ocean froze again. There was also large, grounded polar ice out in the ocean northeast of Cape Halkett. Pieces there never left all summer either. The open leads are usually very far out. In 1932, when I was going out, it would take me all day to get there. The lead is always about 20 to 25 miles out from Esook. This is in winter months where the ice usually opens and closes a little. Sometimes in fall the ice piles up on the shallows east of Cape Halkett. (There was an island there in his father's time which



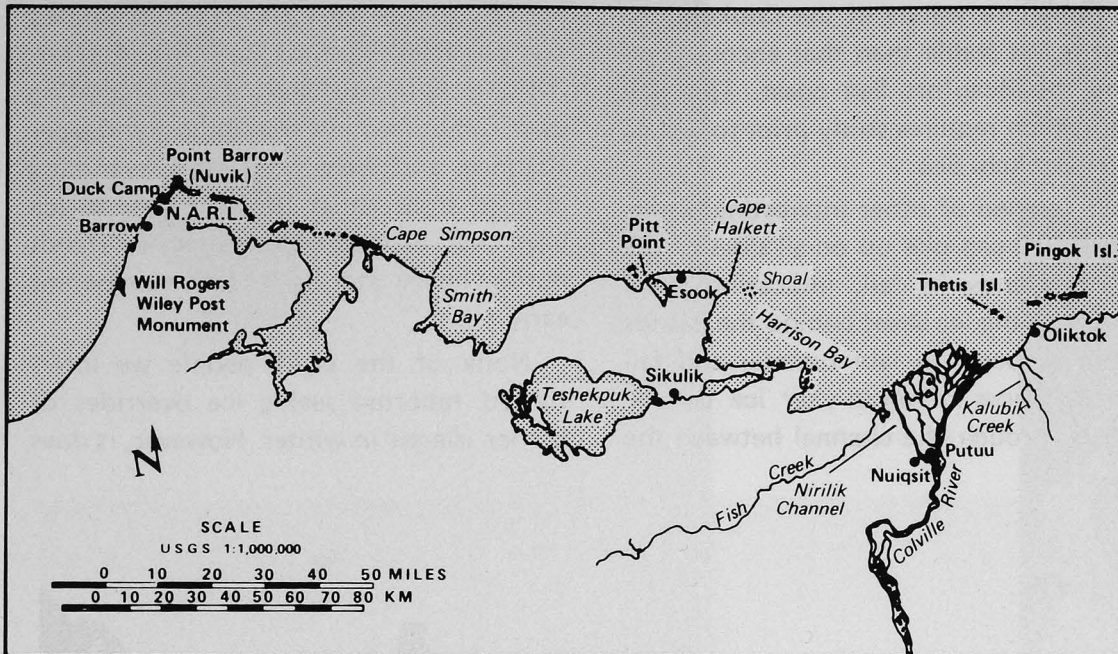


Figure 2. Insert map #2, showing the arctic coast from Barrow to Oliktok (from U.S.G.S. 1:1000000 maps).

is gone now. He remembered this after the interview.) In 1928 (February), there was a one-mile-wide open lead in Harrison Bay, almost in a line from Cape Halkett to Thetis Island, but seaward of the ice pile on that shoal. The wind was from the west. I never traveled on ice very much after that, but this is what I remember seeing."

The lead he describes opening from near Cape Halkett to Thetis Island particularly caught our attention, since the motion involved a translation about one mile seaward of all the landfast ice sheet off Harrison Bay outside the approximately 10-meter depth contour (Fig. 2).

Mr. Itta and Mr. Herbert Leavitt both described an ice push of 4-ft thick ice up the beach at Esook in July of 1928. It

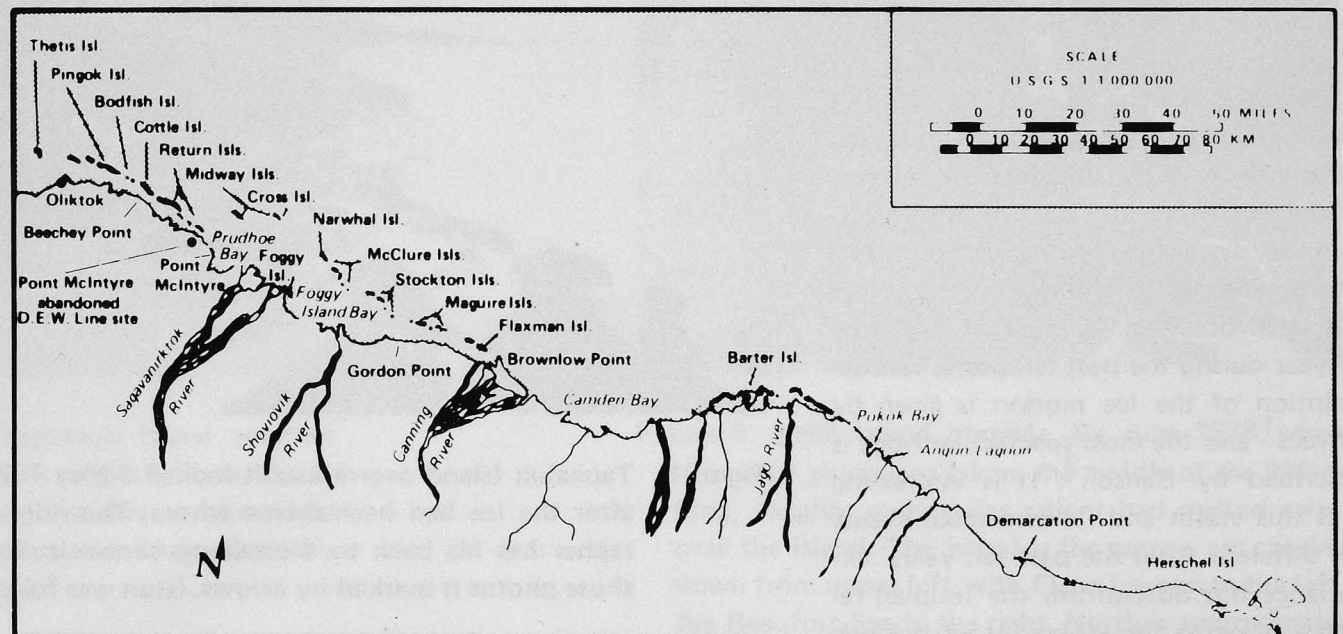
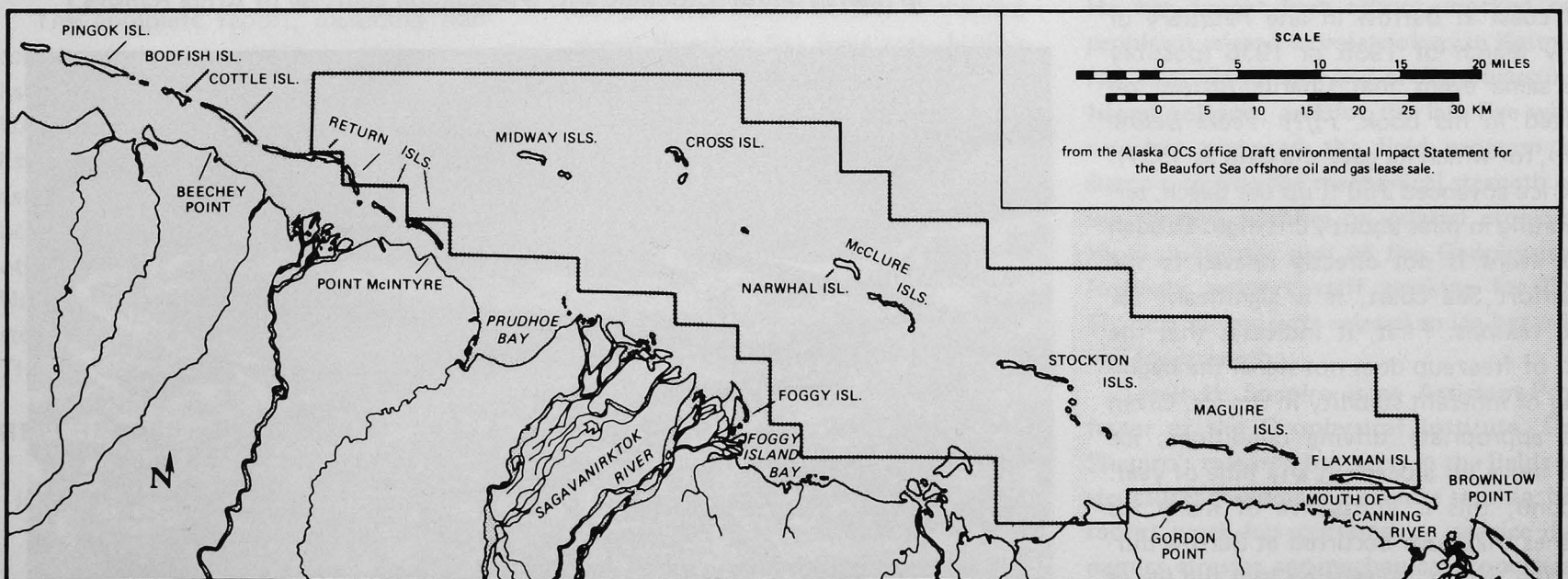


Figure 3. Insert map #3, showing the arctic coast from Oliktok to Herschel Island (from the U.S.G.S. 1:1000000 maps).

Figure 4. Insert map # 4, showing the arctic coast in the lease area (from the Alaska OCS Office Draft Environmental Impact Statement for the Beaufort Sea offshore oil and gas lease sale).





formed piles estimated at 20 ft high along the beach. Over one part of the movement it did not pile up but advanced as a continuous sheet for a distance of 200 ft.

Sarah Kunaknana, Elijah Kakinya, Henry Nashanknik, and Bruce Nukapigak all mention a tendency for a shear zone to form running from Cross Island to Barter Island on the seaward side of those islands (Fig. 3). It is associated with a weather change from gentle winds from the south to very strong winds from the west. This can happen rapidly, as indicated by two stories of hunting parties attempting to reach safety after they had been trapped on the ocean side of the zone when such storms came up. Samuel and Sarah Kunaknana indicated that such events can happen any time of year, regardless of the first-year ice thickness seaward of the barrier islands, if the proper driving conditions prevail.

Between March 16 and 18, 1979 a major storm produced a shear zone and ridge systems in the Beaufort Sea seaward of the barrier islands. The events fit a pattern very similar to the one just described, and the ice moved in an area where it had not been observed to move at that time of year during the past ten years. The description of the ice motion is given by Kovacs<sup>1</sup> and the most spectacular ridge is described by Hanson<sup>2</sup>. It is interesting that this storm and its associated events are different from the past ten years' experience but do confirm the Inupiaq reports, prior to the storm, of what kinds of ice events are possible.

Kenneth Toovak reported an episode of ice overriding the beach on the Chukchi coast at Barrow in late February or early March of 1935 or 1936 (possibly the same event that Charlie Brower reported in his book, *Fifty Years Below Zero*, for which he gave the date as 1937). The ice advanced 250 ft up the beach, terminating in piles about 20 ft high. Though this event is not directly related to the Beaufort Sea coast, it is significant for two reasons. First, it indicates that the end of freezeup does not signal the beginning of inherent stability in the ice. Given the appropriate driving conditions, ice can move up a beach at any time of year. Second, this is illustrative of many ice pushes that have occurred at Barrow during the winter, suggesting that the ice in

the nearshore waters of the Chukchi Sea coast is less stable than that encountered along the Beaufort Sea coast. This is a point which requires study prior to leasing in the Chukchi Sea.

We learned of other interesting events as well. Ice can pile up on all sides of the barrier islands in fall, indicating some motion in the ice sheet behind the islands before January. In late summer and fall storms, pieces of multi-year ice can be carried through the channel between the

Midway and Return Islands and grounded just out from Prudhoe Bay (Fig. 4). During the fall, bowhead whales migrating west sometimes use this and other deeper channels and have been seen swimming inshore from Cross Island. Pieces of ice have been washed up onto barrier islands during heavy storms in late summer or early fall.

None of the eight people we interviewed reported seeing ice overrides of barrier islands in winter. However, it does



**Figure 5.** Tapkaluk Island override as it looked 1 May 1978, more than three months after the ice had been driven ashore. The ridge is 10 m high. The photographer has his back to the salients shown in Figs. 6 and 7; his position in those photos is marked by arrows. (Gun was for defense against polar bears.)

**Figure 6.** Tapkaluk Island override photographed June 1978 to show both salients across the island. The largest section of override was 120 m wide, with 140 m forward thrust. View is from the Beaufort Sea side. Arrow points to man in photo 5, looking left. (Photograph courtesy of Arnie Hanson.)





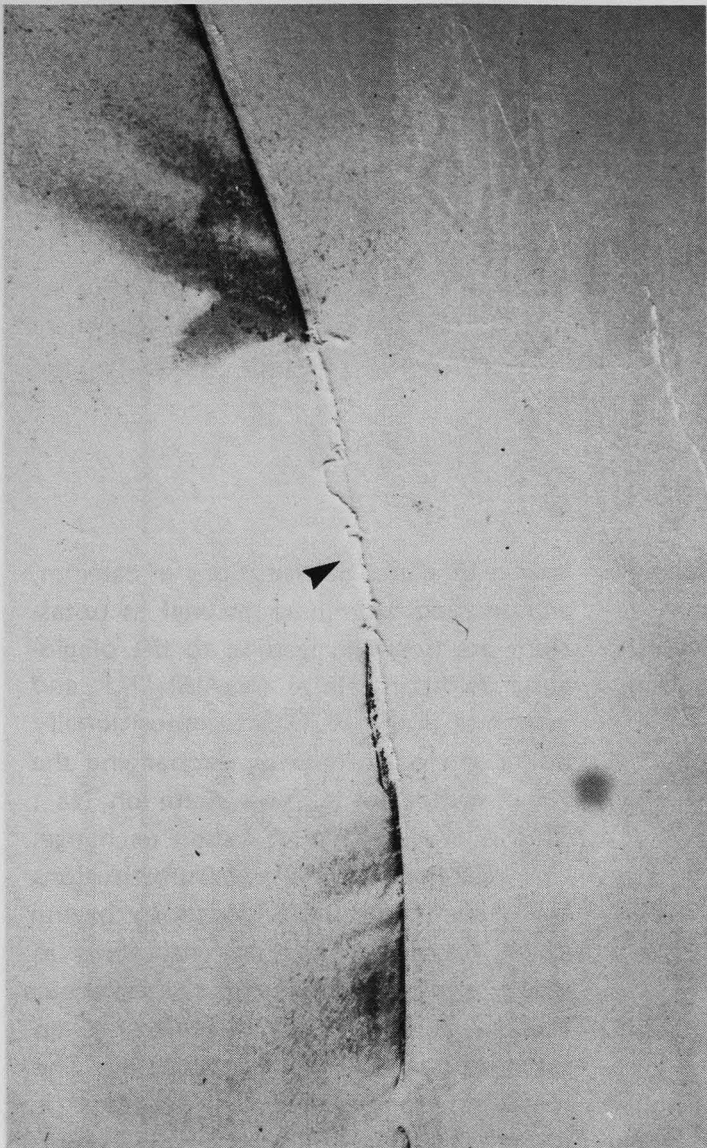


Figure 7. Aerial photo of Tapkaluk Island override 1 May 1978. Elson Lagoon is to the left, the Beaufort Sea to the right. Black streaks are dirt from exposed part of island, blown across lagoon ice by prevailing NE winds.

happen. We documented three such events at Tapkaluk (Figs. 5, 6, and 7), Cooper, and Igalik (Fig. 8) Islands that occurred in January of 1978.<sup>3</sup>

The complete report, including transcripts of the interviews, has been published as Geophysical Institute report UAG R-268. Since the report was published we have learned of two more interesting events. One was an ice push up the beach on the east side of Camden Bay; the other involves motion in the ice between Narwhal Island and the coast during a storm in November or December of 1924. The project is continuing.

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<sup>1</sup>Kovacs, A. 1978 (printed in 1979). Recent ice observations in the Alaskan Beaufort Sea Federal-State lease area.

*The Northern Engineer* 10 (3):7-12.

<sup>2</sup>Hanson, A. and R. Metzner.

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<sup>3</sup>Shapiro, L., H.F. Bates and W.D. Harrison. 1979 (in press). Mechanics of Origin of Pressure Ridges, Shear Ridges and Hummock Fields in Landfast Ice. *In*: Environmental Assessment of the Alaskan Continental Shelf, Annual Report, 1979. NOAA/OCSEAP, Boulder, Colorado, 59 pp.

\* \* \* \*

Ronald C. Metzner holds an M.S. in Geophysics from the University of Alaska.

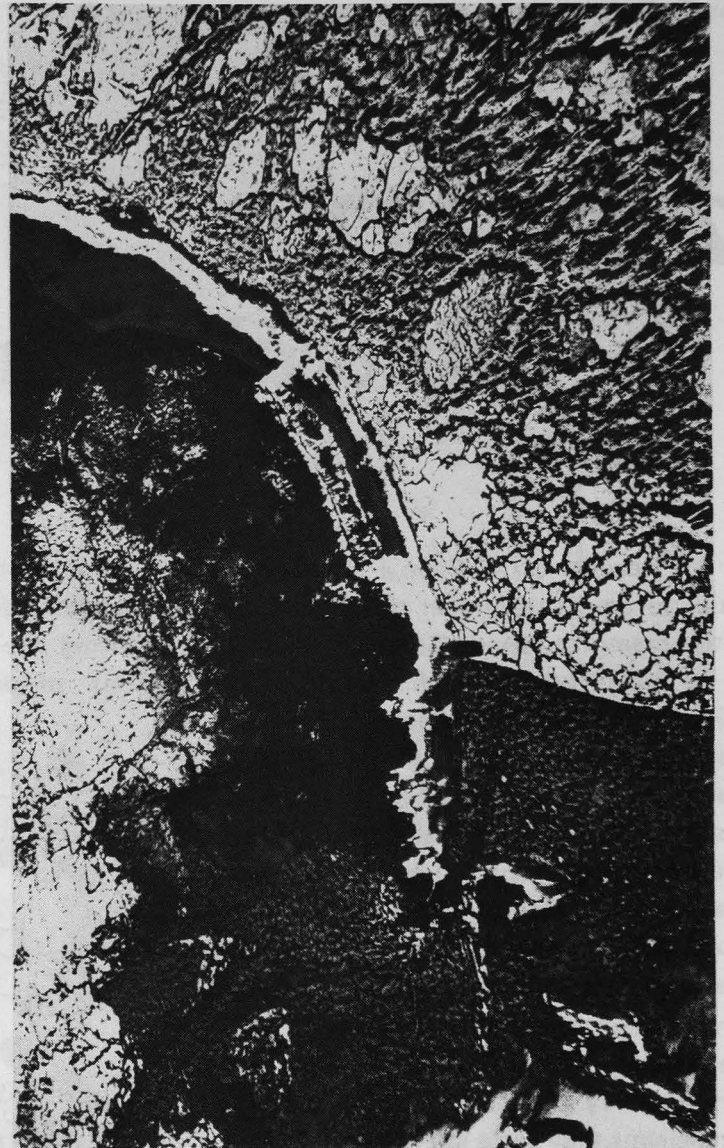


Figure 8. Igalik Island override. By June 1978, when this aerial photo was taken, the middle of the 900-m long, roughly rectangular salient had melted away over the island. The island is the narrow arc curving down from upper left, with Elson Lagoon to the left, the Beaufort Sea to the right. North is approximately upper right corner of the photo. (Photograph courtesy of Arnie Hanson.)

He has taught high school, worked on problems related to volcanology in Katmai National Monument and on St. Augustine Island volcano, and for the last five winters has managed the field program at Barrow testing the mechanical strength of sea ice and working on related projects. He is presently part of the Geophysical Institute support staff working for Dr. Shapiro on projects related to ice hazards and ice strength.

Lewis H. Shapiro is an Assistant Professor at the Geophysical Institute. Dr. Shapiro's research has been in the fields of structural geology and remote sensing; his recent work has centered on sea ice dynamics, stresses, and mechanical properties.



## AUTHOR'S NOTE

*Added in press for*

### Ice Conditions on Alaska's Beaufort Sea Coast: Extending the Observations

We include this note because our article may give the impression that an oral agreement and payment for information are sufficient from a legal point of view to protect the institution which acquired the tape from future litigation. This is not at all certain. Thus, since the work reported here, we have adopted the use of a simple deed of gift to the Geophysical Institute for the tapes received. It states the name of the person interviewed, the name of the person conducting the interview, the nature of the interview, the purpose for which the tape will be used, and what the Geophysical Institute agrees to do in return for the tape.

We tried to keep it as simple as possible, since too much paperwork becomes awkward during interviews and we want people to understand what they are signing. We got the idea for the deed of gift from a little book entitled *Local History Collections, A Manual for Librarians*, by Enid Thompson. It is published by the American Association for State and Local History in Nashville, Tennessee. Below is a copy of the form we use; we have it filled out, dated, and signed by the person being interviewed at the time the tape is made. We pay them immediately after the tape is completed, so it also serves as a cash receipt for our records, and we give a copy to the person who was interviewed.

-- R. Metzner and L. Shapiro

DEED OF GIFT	DATE _____
Total time for the interview	_____

I \_\_\_\_\_ agree to have this interview with \_\_\_\_\_  
\_\_\_\_\_ tape recorded and give the tape to the Geophysical Institute of the University of Alaska to provide information about sea ice and related matters that I think might be of interest to them. This information will be included in a public report about sea ice hazards. In return they will pay me \$ \_\_\_\_\_ for my time and send me a copy of the final report when it's completed.

Signed \_\_\_\_\_