Extreme Summer Melt

Assessing the Habitability and Physical Structure of Rotting First-year Arctic Sea Ice

Narrator: The team of University of Washington researchers working to find and categorize "rotten" sea ice traveled to the ice off Barrow, Alaska, three times in the spring and summer of 2015.

Bonnie Light: What I was looking for in May was ice that had not yet been touched by the sun. So, if it's flat and it's level and it's under snow cover, it hasn't really seen the light of day yet.

Narrator: In June, they found melting ice.

Light: And of course in June, you just look off the beach and the first thing you see is this contrast between areas that are ponded and areas that are bare. And you immediately say: that ice is different. And so, the visual impression of it tells a lot about the nature of the ice and the structure of it.

Narrator: And in July, they found truly rotten ice.

Light: In July, this ice was different. It had suffered considerably and the surface was very rumpled. And the texture of it was very coarse. It was kind of riddled with drainage holes.

Karen Junge: We did find some very flat, uniform ice floes that were clear. They were rotten through the whole length of the core. So, that was exciting to see.

Carie Frantz: I had no idea what to expect because this was my first time, really, on sea ice. And everybody previously that we had talked to said "You're never gonna be able to core this ice. It's gonna fall apart. It's gonna be all slush." We cored it, and it was intact ice with big holey bits that was breaking apart as we were standing on it. And as I was pumping the sample, this crack just goes (CRACKING NOISE) and connects all the holes.

Light: Yeah, the ice we found in July was more rotten than my wildest dreams.

Junge: It's so different just thinking about it versus having it your hands and seeing it and I – just like others on my team – was just amazed at how big those channels were.

Narrator: Finding and working with rotten ice was difficult in July. But the team was able to run field experiments and prepare samples on the ice floes and in the Barrow lab much as they had done in May and June.

Frantz: Shelly started drilling the cores and we drilled upwards of 22 cores each time we went out. We were collecting cores for doing melts, looking at chemical and biological parameters. We drilled cores for optical measurements. We cut them up in little pieces to measure density and temperature. Monica was doing reads of photo-synthetically active radiation to try to understand what the light environment was for the organisms in the ice.

Junge: Part of this project is to have this microscope set up in the cold room and look at these thin sections and look inside the ice to see the ice structure but also the organisms within.

In Barrow, we actually prepared the ice samples in an artificial sea water solution so the osmotic shock to the organisms within is reduced.

Shelly Carpenter: It melts really slow. The bugs - we're assuming – are happier – because they are not freshened. And then we can get accurate numbers when we do our processing for organisms.

Junge: Some samples were filtered to determine the amount of polymers in these samples.

Light: We took optical cores while we were in the field. We put the cores in sleeves and hauled them back to the lab and I was able to work with them in the lab and cut them down into just ten centimeter sections, looking at the optical properties of those sections.

People have been writing in their papers for quite awhile now – in general, the ice gets more transparent as the spring transitions into summer. And we know that that is certainly true for the ice cover as a whole. But is that really true about the ice? My hunch was that it wasn't necessarily true: that the ice should actually be less transparent as the season progresses. This ice is getting less and less transparent as it's warming and the occlusions in it get larger and scatter more light.

Junge: So now we are here. We've got the filters that need to be sent through the machines. They need to be analyzed with a microscope, a flow cytometer. DNA needs to be extracted for further compositional analysis, and also of course for the microscopy again. So we have the microscope set up back here in the cold room to study thin sections and develop more of these staining procedures so we can get some good images of these organisms in the ice.

Monica Orellana: The cells and the gels I will count with flow cytometry. A flow cytometer is an instrument that can measure and count cells or particles in flow so that you can see different populations of algae or bacteria, polymers and you can see in time how these populations change.

Frantz: We have beautiful profiles of temperature and how that changes with time and same with salinity. So the density of the May and June cores was very similar. But the July cores are a lot less dense. And that's because there are holes in them.

Light: Right now, we're in the business of trying to figure out what questions to really start asking about this new ice type – this rotten ice. And the first step in asking good questions is to have a good characterization.

Narrator: Characterization of the physical, biological, and chemical nature of rotting first-year ice continues. Constructing a picture of how the ice and microbial communities change during the summer may ultimately tell a story of how Arctic sea ice survives to the end of the melt season.

This is APL — The Applied Physics Laboratory at the University of Washington in Seattle.