
EPISODE SEVEN:
PERMAFROST

1
00:00:00,060 --> 00:00:04,090
[Music rises] Sturm: What we're looking at is a lecacy of the ice age.

2
00:00:04,090 --> 00:00:08,200
Permafrost and methane

3
00:00:08,200 --> 00:00:12,400
is a time machine.

4
00:00:12,400 --> 00:00:16,500
So what we’re going to do is walk back in time. We’re gonna see old carbon,

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00:00:16,500 --> 00:00:20,620
old bones, old environments.

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00:00:20,620 --> 00:00:24,820
And none of those are in equilibrium with today’s climate so that’s the problem.

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00:00:24,820 --> 00:00:28,890
That world doesn’t exist anymore and it hasn’t for 10,000 years.

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00:00:28,890 --> 00:00:32,970
It was nicely and very delicately

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00:00:32,970 --> 00:00:37,060
separated from this modern warmer climate by about

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00:00:37,060 --> 00:00:41,150
this much moss. And when that moss goes away

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00:00:41,150 --> 00:00:45,330
whether through fire or for human disturbance

12
00:00:45,330 --> 00:00:49,400
or for warming, then all hell breaks loose.

13
00:00:49,400 --> 00:00:53,620

[lively opening credit music]

14
00:01:06,050 --> 00:01:10,230
[music fades]

15
00:01:10,230 --> 00:01:14,370
Narrator: Permafrost – it’s maybe the part of the cryosphere that’s most out of sight

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00:01:14,370 --> 00:01:18,560
… and mind. It’s fascinating how it formed in the first place,

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00:01:18,560 --> 00:01:22,650
and how it got loaded with so much carbon.

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00:01:22,650 --> 00:01:26,750
In a minute, we’ll go back underground with Matthew Sturm from the University of Alaska Fairbanks.

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00:01:26,750 --> 00:01:30,900
But first let’s meet Peter Griffith,

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00:01:30,900 --> 00:01:35,050
NASA’s project manager for the ABoVE Campaign, which supports more than

21
00:01:35,050 --> 00:01:39,090
70 science projects studying changing forests and tundra vegetation,

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00:01:39,090 --> 00:01:43,260
wild fires, animals like birds, caribou,

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00:01:43,260 --> 00:01:47,320
and Dall sheep, methane emissions from expanding northern lakes,

24
00:01:47,320 --> 00:01:51,500
and the impacts of climate change on people in Alaska, Canada

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00:01:51,500 --> 00:01:55,670
… and around the world. Many of those projects have some direct

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00:01:55,670 --> 00:01:59,830
connection to the permafrost. Griffith: Permafrost is the

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00:01:59,830 --> 00:02:03,930
hidden cryosphere. It’s the permanently frozen soil

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00:02:03,930 --> 00:02:08,060
that surrounds the Arctic. All across Alaska and northern Canada and then

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00:02:08,060 --> 00:02:12,230
across Eurasia, the ground has been frozen

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00:02:12,230 --> 00:02:16,270
during the Ice Ages.

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00:02:16,270 --> 00:02:20,380
Narrator: During the ice ages, there was not enough snowfall in the drier regions of Alaska and Canada

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00:02:20,380 --> 00:02:24,550
to form glaciers there, so the land was suitable for vegetation.

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00:02:24,550 --> 00:02:28,700
Griffith: What happened is that over thousands and thousands of years, all of that

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00:02:28,700 --> 00:02:32,810
plant material got compacted and frozen every winter and buried

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00:02:32,810 --> 00:02:36,960
and pushed down, so that today, there’s 300 feet deep

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00:02:36,960 --> 00:02:41,100
of frozen water and dead plants and

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00:02:41,100 --> 00:02:45,130
some pieces of dead animals, too. Sometimes, you’d find

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00:02:45,130 --> 00:02:49,180

woolly mammoths in the permafrost. But most of it,

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00:02:49,180 --> 00:02:53,300
of the organic matter as we call it in the permafrost

40
00:02:53,300 --> 00:02:57,460
is frozen plant material.

41
00:02:57,460 --> 00:03:01,520
Narrator: Some of that plant material is now thawing and decaying, releasing its ancient

42
00:03:01,520 --> 00:03:05,620
carbon into the atmosphere, sometimes in the form of methane gas

43
00:03:05,620 --> 00:03:09,690
bubbling out of expanding northern lakes.

44
00:03:09,690 --> 00:03:13,810
Griffith: We started this field campaign because

45
00:03:13,810 --> 00:03:17,940
the Arctic is the part of the planet that is warming first and fastest

46
00:03:17,940 --> 00:03:22,130
and there are consequences to this for permafrost.

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00:03:22,130 --> 00:03:26,240
During the Arctic-Boreal Vulnerability Experiment, we're studying permafrost

48
00:03:26,240 --> 00:03:30,350
with people on the ground, from aircraft flying

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00:03:30,350 --> 00:03:34,520
over the region, and also from satellites in space.

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00:03:34,520 --> 00:03:38,720
Narrator: Another way to understand the permafrost is take a walk

51
00:03:38,720 --> 00:03:42,790
below ground with Matthew Sturm, and into the

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00:03:42,790 --> 00:03:46,900
U.S. Army Corps of Engineers permafrost tunnel.

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00:03:46,900 --> 00:03:51,040
Griffith: And they've dug this tunnel back into the side of a hill about 200 feet.

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00:03:51,040 --> 00:03:55,250
And it goes sort of sloping down,

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00:03:55,250 --> 00:03:59,340
so that by the end of the tunnel, you're about 100 feet underground.

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00:03:59,340 --> 00:04:03,420
And you're surrounded by bones sticking out of the wall

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00:04:03,420 --> 00:04:07,510
from the steppe bison and the mastodons

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00:04:07,510 --> 00:04:11,640
that are frozen in it. There's sticks that are 40,000 years old

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00:04:11,640 --> 00:04:15,690
you know, that you can touch with your hand. There's grass that's still green

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00:04:15,690 --> 00:04:19,920
that's tens of thousands of years because it got frozen

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00:04:19,920 --> 00:04:23,990
right away and it's never lost the green color.

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00:04:23,990 --> 00:04:28,090
Narrator: But as fascinating as it is to see these relics of an ancient era,

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00:04:28,090 --> 00:04:32,210

or to see a tree split in half by thawing soil,

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00:04:32,210 --> 00:04:36,380
or even to light a ball of methane on fire from under winter ice …

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00:04:36,380 --> 00:04:40,460
at the end of the day Peter and his colleagues want to know just how much organic matter

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00:04:40,460 --> 00:04:44,580
is frozen in that permafrost, and how fast it might be released.

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00:04:44,580 --> 00:04:48,670
Griffith: Currently we think that there is

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00:04:48,670 --> 00:04:52,840
something on the order of two to three times

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00:04:52,840 --> 00:04:56,900
as much carbon locked up as

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00:04:56,900 --> 00:05:00,970
frozen organic matter and permafrost, as there is carbon dioxide in the atmosphere.

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00:05:00,970 --> 00:05:05,110
So, releasing

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00:05:05,110 --> 00:05:09,140
all of that organic carbon from permafrost into the atmosphere,

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00:05:09,140 --> 00:05:13,240
would be a real game-changer. That would be a tremendous

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00:05:13,240 --> 00:05:17,340
transformation of the planet’s atmosphere. Now, the good news

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00:05:17,340 --> 00:05:21,550
is that it would take a very, very long time for that to happen.

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00:05:21,550 --> 00:05:25,640
However, we are warming the planet

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00:05:25,640 --> 00:05:29,710
at a rate now that calls in to question, how quickly

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00:05:29,710 --> 00:05:33,840
is that changing, and what the consequences

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00:05:33,840 --> 00:05:37,950
in the near future and in the far future are going to be.

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00:05:37,950 --> 00:05:42,010
[Music, sounds of a crowd chatting]

81
00:05:42,010 --> 00:05:46,070
Neumann: You're in a field, somewhere in California at four in the morning.

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00:05:46,070 --> 00:05:50,230
It's sort of surreal in a way. Because, you've put so much time into it for