1
00:00:10,379 --> 00:00:08,250
okay all right so my name is Brandon

2
00:00:12,330 --> 00:00:10,389
Stackhouse I'm from Princeton I go I

3
00:00:14,869 --> 00:00:12,340
work with the onstott laboratory there

4
00:00:16,890 --> 00:00:14,879
and i'll be speaking a little bit about

5
00:00:18,990 --> 00:00:16,900
this experiment that we've been running

6
00:00:21,240 --> 00:00:19,000
for a while looking at gas fluxes out of

7
00:00:23,010 --> 00:00:21,250
these cores we've collected from the

8
00:00:24,930 --> 00:00:23,020
High Arctic that have been undergoing

9
00:00:26,790 --> 00:00:24,940
this progressive thorium and sort of

10
00:00:29,790 --> 00:00:26,800
what we've been seeing there so we'll be

11
00:00:31,320 --> 00:00:29,800
discussing mainly flux and pour gas data

12
00:00:32,939 --> 00:00:31,330
but we'll be touching a little bit on

13
00:00:34,590 --> 00:00:32,949

some modeling efforts that we've been

14
00:00:38,069 --> 00:00:34,600
doing as well to look at this problem

15
00:00:39,540 --> 00:00:38,079
and a little bit about the microbial

16
00:00:43,259 --> 00:00:39,550
community that's present in this area as

17
00:00:44,939 --> 00:00:43,269
well so there's been this sort of

18
00:00:48,020 --> 00:00:44,949
amazing body of work that's shown up

19
00:00:51,059 --> 00:00:48,030
over the past 10 to 15 years looking at

20
00:00:55,259 --> 00:00:51,069
communities in cold environments all

21
00:00:57,419 --> 00:00:55,269
these cycra files and it's it's gone on

22
00:00:59,939 --> 00:00:57,429
this amazing amazing argit's going not

23
00:01:01,559 --> 00:00:59,949
just from we see these microbes present

24
00:01:03,180 --> 00:01:01,569
in these cold environments where these

25
00:01:05,070 --> 00:01:03,190
sub-zero temperatures or froze and stuff

26
00:01:07,530 --> 00:01:05,080
too we see them actually actively

27
00:01:09,030 --> 00:01:07,540
metabolizing in these environments which

28
00:01:10,620 --> 00:01:09,040
is incredibly important because if

29
00:01:13,290 --> 00:01:10,630
they're just sitting there you get

30
00:01:15,300 --> 00:01:13,300
long-term damage to DNA by radiation or

31
00:01:17,310 --> 00:01:15,310
just entropic decay but if you can

32
00:01:19,440 --> 00:01:17,320
metabolize you can repair your DNA down

33
00:01:21,390 --> 00:01:19,450
there that gives you a much much longer

34
00:01:24,030 --> 00:01:21,400
life to sit in these cold permafrost

35
00:01:26,190 --> 00:01:24,040
environments and be a viable organism

36
00:01:27,930 --> 00:01:26,200
above and beyond that we've recently

37
00:01:30,510 --> 00:01:27,940
started seeing guys that can grow at

38
00:01:33,180 --> 00:01:30,520

incredibly low low temperatures 10

39
00:01:35,670 --> 00:01:33,190
degrees C recent paper from minus 15

40
00:01:37,530 --> 00:01:35,680
degrees C from McGill here where we see

41
00:01:39,000 --> 00:01:37,540
things that not just metabolize but

42
00:01:42,330 --> 00:01:39,010
they're actually increase in their

43
00:01:44,400 --> 00:01:42,340
community size potentially at these at

44
00:01:45,960 --> 00:01:44,410
these very low temperatures that gives

45
00:01:47,670 --> 00:01:45,970
you a chance to just increase your bio

46
00:01:51,240 --> 00:01:47,680
mass at these areas not just metabolize

47
00:01:53,220 --> 00:01:51,250
not just repair your DNA so this has

48
00:01:54,780 --> 00:01:53,230
been a really exciting area especially

49
00:01:57,510 --> 00:01:54,790
in terms of its astrobiology

50
00:01:58,920 --> 00:01:57,520
implications and what you see is that

51
00:02:02,730 --> 00:01:58,930
these guys are all from permafrost

52
00:02:04,980 --> 00:02:02,740
permafrost permafrost so what we want to

53
00:02:06,810 --> 00:02:04,990
do is look at these kinds of

54
00:02:09,930 --> 00:02:06,820
environments and see how they relate to

55
00:02:11,880 --> 00:02:09,940
other areas so permafrost terrain for

56
00:02:13,920 --> 00:02:11,890
those of you who maybe need a little bit

57
00:02:16,470 --> 00:02:13,930
of a refresher it's this patterned

58
00:02:17,940 --> 00:02:16,480
ground that we see in polar regions so

59
00:02:19,350 --> 00:02:17,950
you have the art to give the Antarctic

60
00:02:21,390 --> 00:02:19,360
and it's dick

61
00:02:22,740 --> 00:02:21,400
by this freeze-thaw cycle that happens

62
00:02:25,410 --> 00:02:22,750
every year where during the summer

63
00:02:27,180 --> 00:02:25,420

everything thaws from the top down to

64
00:02:29,490 --> 00:02:27,190
some stable active layer depth where the

65
00:02:31,680 --> 00:02:29,500
permafrost begins and it's this

66
00:02:34,800 --> 00:02:31,690
freeze-thaw cycle that generates this

67
00:02:36,840 --> 00:02:34,810
very regular behavior in the in the

68
00:02:39,540 --> 00:02:36,850
ground this very specific type of

69
00:02:41,670 --> 00:02:39,550
morphology that happens there and you

70
00:02:43,530 --> 00:02:41,680
develop these large ice wedges in

71
00:02:45,810 --> 00:02:43,540
certain areas you can get ice lenses

72
00:02:48,720 --> 00:02:45,820
which is very ice rich kind of

73
00:02:51,650 --> 00:02:48,730
environment in these frozen soils and

74
00:02:54,120 --> 00:02:51,660
it's Astra biologically relevant because

75
00:02:56,850 --> 00:02:54,130
much like we see in other areas it's

76
00:02:58,740 --> 00:02:56,860
very low temperatures so a lot of areas

77
00:03:00,600 --> 00:02:58,750
during the winter you get temperatures

78
00:03:03,060 --> 00:03:00,610
down minus-40 minus-50 degrees

79
00:03:05,460 --> 00:03:03,070
centigrade and that also means you have

80
00:03:07,620 --> 00:03:05,470
a very low liquid water availability for

81
00:03:09,479 --> 00:03:07,630
these microbes to exist in where things

82
00:03:12,660 --> 00:03:09,489
are existing either in brines or these

83
00:03:17,760 --> 00:03:12,670
uh very thin water layers on top of ice

84
00:03:19,140 --> 00:03:17,770
that's down in the subsurface so that's

85
00:03:20,729 --> 00:03:19,150
a that's a really cool thing that we see

86
00:03:23,910 --> 00:03:20,739
these microbes that live in these types

87
00:03:25,620 --> 00:03:23,920
of environments it's also really cool

88
00:03:28,410 --> 00:03:25,630

that we see similar environments to this

89
00:03:30,990 --> 00:03:28,420
on Mars so over here we can see pattern

90
00:03:33,150 --> 00:03:31,000
terrain from the Utopia basin which is

91
00:03:36,890 --> 00:03:33,160
up in the northern hemisphere of Mars

92
00:03:40,050 --> 00:03:36,900
right over here I think and looking at

93
00:03:42,300 --> 00:03:40,060
orbital data people have looked at

94
00:03:44,310 --> 00:03:42,310
regions where they see evidence and the

95
00:03:47,370 --> 00:03:44,320
ground features that indicate that

96
00:03:50,009 --> 00:03:47,380
there's near-surface stable ground ice

97
00:03:52,920 --> 00:03:50,019
in Mars not too far below the dirt where

98
00:03:56,039 --> 00:03:52,930
you'll have you'll have liquid or not

99
00:03:58,890 --> 00:03:56,049
like I'm sorry uh solid ice that's

100
00:04:01,590 --> 00:03:58,900
present in may extend four extend Pro

101
00:04:03,150 --> 00:04:01,600
ways down into the ground and I was

102
00:04:04,259 --> 00:04:03,160
agonizing for a while getting this talk

103
00:04:06,930 --> 00:04:04,269
return to figure out how am I going to

104
00:04:08,580 --> 00:04:06,940
convince you guys that there's the

105
00:04:09,630 --> 00:04:08,590
possibility even though it's ground ice

106
00:04:11,130 --> 00:04:09,640
here that maybe there's some liquid

107
00:04:13,500 --> 00:04:11,140
water here where these micronians

108
00:04:16,680 --> 00:04:13,510
couldn't exist and I was so happy

109
00:04:19,740 --> 00:04:16,690
yesterday that two talks back to back

110
00:04:22,409 --> 00:04:19,750
did most of my heavy lifting for me so

111
00:04:24,360 --> 00:04:22,419
the talk that Harvey gave looking at the

112
00:04:28,589 --> 00:04:24,370
formation of liquid brians from

113
00:04:30,240 --> 00:04:28,599

telepresence in these in these salt

114
00:04:32,990 --> 00:04:30,250
environments that were seen there and

115
00:04:37,650 --> 00:04:33,000
then the talk by Brendan about

116
00:04:39,090 --> 00:04:37,660
these streaks slope features that people

117
00:04:42,750 --> 00:04:39,100
have seen on Mars that we have analogs

118
00:04:45,840 --> 00:04:42,760
for on earth and that that was fantastic

119
00:04:47,970 --> 00:04:45,850
and so we look at this one we say okay

120
00:04:49,710 --> 00:04:47,980
maybe you have these liquid brines these

121
00:04:51,510 --> 00:04:49,720
organisms the water that's there it

122
00:04:53,730 --> 00:04:51,520
would have to be very salty water that

123
00:04:57,000 --> 00:04:53,740
their existing in that's okay the areas

124
00:04:58,710 --> 00:04:57,010
that we've done these isolations from on

125
00:05:00,210 --> 00:04:58,720
earth a lot of them are from these

126
00:05:02,520 --> 00:05:00,220
liquid Brian environments their halo

127
00:05:04,290 --> 00:05:02,530
files they're okay with that we look at

128
00:05:06,270 --> 00:05:04,300
these streaks slope things and people

129
00:05:08,600 --> 00:05:06,280
say if exists it's very temporary that's

130
00:05:10,680 --> 00:05:08,610
okay to these organisms that we see in

131
00:05:12,780 --> 00:05:10,690
in the Arctic they're used to only

132
00:05:15,600 --> 00:05:12,790
having temporary access to liquid water

133
00:05:17,370 --> 00:05:15,610
during times that they have you know the

134
00:05:18,990 --> 00:05:17,380
winter when they're still metabolizing

135
00:05:21,840 --> 00:05:19,000
they get very very little water they're

136
00:05:24,270 --> 00:05:21,850
frozen most of the time so salty

137
00:05:26,160 --> 00:05:24,280
temporary that's okay the fact that it's

138
00:05:27,810 --> 00:05:26,170

there at all it's very important it

139
00:05:30,030 --> 00:05:27,820
gives them a chance to increase their

140
00:05:31,500 --> 00:05:30,040
deposit give you city or eight get rid

141
00:05:33,450 --> 00:05:31,510
of some of their waste byproducts get

142
00:05:36,390 --> 00:05:33,460
new oxidants in their system they're

143
00:05:40,890 --> 00:05:36,400
happy to even see it at all so that that

144
00:05:45,150 --> 00:05:40,900
makes our life a lot easier so the work

145
00:05:48,270 --> 00:05:45,160
that we've been doing is up in axel

146
00:05:50,940 --> 00:05:48,280
Heiberg Island which we're using as an

147
00:05:53,790 --> 00:05:50,950
analog site for some places on Mars it's

148
00:05:54,840 --> 00:05:53,800
not it's not a perfect analogue but you

149
00:05:58,230 --> 00:05:54,850
know you squint your eyes a little bit

150
00:06:00,450 --> 00:05:58,240
on a warm day on Mars is a nice cold day

151
00:06:02,130 --> 00:06:00,460
up in the architecture the pressure is

152
00:06:04,860 --> 00:06:02,140
different you got some oxygen but you

153
00:06:10,260 --> 00:06:04,870
know this this is not bad it is not bad

154
00:06:11,940 --> 00:06:10,270
in the end so here's our field site I'm

155
00:06:15,180 --> 00:06:11,950
fortunate to work up the McGill Arctic

156
00:06:17,220 --> 00:06:15,190
research station which is at oh hello 79

157
00:06:18,810 --> 00:06:17,230
degrees north it has a mean annual air

158
00:06:21,420 --> 00:06:18,820
temperature of minus 19 degrees

159
00:06:24,630 --> 00:06:21,430
centigrade and it's characterized by

160
00:06:26,640 --> 00:06:24,640
being a very low organic carbon soy only

161
00:06:28,980 --> 00:06:26,650
about 1% organic carbon that's president

162
00:06:33,350 --> 00:06:28,990
there and it's also a moist acidic

163
00:06:35,580 --> 00:06:33,360

tundra so our ground is about 4.5 to 5.5

164
00:06:37,980 --> 00:06:35,590
for the pH in terms of the ground water

165
00:06:40,170 --> 00:06:37,990
and a ground soil so here's a picture of

166
00:06:42,330 --> 00:06:40,180
it in the winter you get this nice snow

167
00:06:43,650 --> 00:06:42,340
cover here's it during the summer and

168
00:06:46,050 --> 00:06:43,660
what you can tell from this photo is

169
00:06:46,500 --> 00:06:46,060
that you really don't have much in terms

170
00:06:48,690 --> 00:06:46,510
of plane

171
00:06:51,030 --> 00:06:48,700
it cover this is you're not driving much

172
00:06:52,950 --> 00:06:51,040
of your organic carbon from plants you

173
00:06:55,740 --> 00:06:52,960
have a fairer keema with autotrophic

174
00:06:58,740 --> 00:06:55,750
community here that's derived most of

175
00:07:02,340 --> 00:06:58,750
the most most of the carbon cycling that

176
00:07:06,150 --> 00:07:02,350
happens in one of in a lot of areas so

177
00:07:08,880 --> 00:07:06,160
we went up there in end winter to drill

178
00:07:11,880 --> 00:07:08,890
a bunch of permafrost cores and if

179
00:07:15,990 --> 00:07:11,890
you've never drilled in the Arctic in

180
00:07:19,320 --> 00:07:16,000
the winter it is a special type of hell

181
00:07:20,310 --> 00:07:19,330
that is reserved by advisers for grad

182
00:07:23,040 --> 00:07:20,320
students they don't think are working

183
00:07:25,200 --> 00:07:23,050
hard enough so I got to spend two weeks

184
00:07:28,920 --> 00:07:25,210
up there with Guillaume right over there

185
00:07:31,230 --> 00:07:28,930
and we drilled about 40 1 meter

186
00:07:32,390 --> 00:07:31,240
permafrost cores and it's important that

187
00:07:35,340 --> 00:07:32,400
we collected them in the winter because

188
00:07:38,220 --> 00:07:35,350

since all the soil was still frozen it

189
00:07:40,590 --> 00:07:38,230
means that the gas composition of the

190
00:07:42,240 --> 00:07:40,600
pore water that's there is going to be

191
00:07:44,280 --> 00:07:42,250
reflective of what the environment was

192
00:07:46,920 --> 00:07:44,290
like when this witness environment froze

193
00:07:49,680 --> 00:07:46,930
at the at the onset of winter the

194
00:07:51,570 --> 00:07:49,690
previous the previous year that means as

195
00:07:54,180 --> 00:07:51,580
we do our thawing we can actually go

196
00:07:57,090 --> 00:07:54,190
back and sample what that looked like

197
00:07:59,750 --> 00:07:57,100
before hand plus whatever respiration

198
00:08:03,000 --> 00:07:59,760
was occurring during the winter months

199
00:08:04,470 --> 00:08:03,010
so the way our experiment looked is we

200
00:08:06,300 --> 00:08:04,480
did this progressive thaw from the top

201
00:08:08,760 --> 00:08:06,310
down here's just a quick look at the

202
00:08:11,370 --> 00:08:08,770
temperature profile where you can see

203
00:08:13,350 --> 00:08:11,380
that over the course of several weeks we

204
00:08:15,750 --> 00:08:13,360
progressively brought up sections of the

205
00:08:17,130 --> 00:08:15,760
core two above freezing to a maximum

206
00:08:19,800 --> 00:08:17,140
temperature about four degrees

207
00:08:22,410 --> 00:08:19,810
centigrade and over the course of this

208
00:08:25,290 --> 00:08:22,420
thong experiment we were measuring the

209
00:08:28,010 --> 00:08:25,300
concentration of trace gases in the

210
00:08:31,230 --> 00:08:28,020
headspace as well as major components so

211
00:08:34,890 --> 00:08:31,240
nitrogen and oxygen co2 methane that

212
00:08:37,469 --> 00:08:34,900
sort of thing and we were also sampling

213
00:08:39,570 --> 00:08:37,479

the pore water and that adds several

214
00:08:41,400 --> 00:08:39,580
depths down the course we had about five

215
00:08:44,670 --> 00:08:41,410
centimeters 35 centimeters 65

216
00:08:46,710 --> 00:08:44,680
centimetres and then one sampling port

217
00:08:48,630 --> 00:08:46,720
to be placed into the permafrost itself

218
00:08:51,930 --> 00:08:48,640
so when we thought the permafrost we

219
00:08:54,360 --> 00:08:51,940
could get a look at what that was doing

220
00:08:56,280 --> 00:08:54,370
down there as well over the course of

221
00:08:59,860 --> 00:08:56,290
this experiment we also collected soil

222
00:09:02,800 --> 00:08:59,870
samples to do DNA extraction

223
00:09:05,740 --> 00:09:02,810
to look at the meta-genome of profile oh

224
00:09:08,260 --> 00:09:05,750
my goodness okay all right so we're

225
00:09:10,780 --> 00:09:08,270
going to move up fast over here so

226
00:09:13,180 --> 00:09:10,790
looking at the head space during Thal we

227
00:09:15,070 --> 00:09:13,190
see this ink we see this release of

228
00:09:18,700 --> 00:09:15,080
methane that occurs and it drops down to

229
00:09:20,500 --> 00:09:18,710
near zero values we were expecting to

230
00:09:23,079 --> 00:09:20,510
see this increase during the initial

231
00:09:24,910 --> 00:09:23,089
thaw it's been seen in other areas but

232
00:09:26,470 --> 00:09:24,920
we didn't see a pick up afterwards which

233
00:09:28,660 --> 00:09:26,480
we are expecting to we thought meth an

234
00:09:30,340 --> 00:09:28,670
agenda sustained at some point and you'd

235
00:09:33,579 --> 00:09:30,350
see the production of methane going on

236
00:09:35,290 --> 00:09:33,589
which you really didn't see very much so

237
00:09:37,240 --> 00:09:35,300
when we start investigating what's going

238
00:09:40,570 --> 00:09:37,250

on in the poor gas during this time

239
00:09:42,820 --> 00:09:40,580
period as well I want you to look at

240
00:09:44,350 --> 00:09:42,830
these X's right here this is our

241
00:09:47,110 --> 00:09:44,360
saturated treatments these are

242
00:09:49,420 --> 00:09:47,120
unsaturated treatments for this falling

243
00:09:51,579 --> 00:09:49,430
experiment we can see an unsaturated the

244
00:09:53,800 --> 00:09:51,589
poor gas composition of methane

245
00:09:56,110 --> 00:09:53,810
decreases rather significantly and it

246
00:09:58,540 --> 00:09:56,120
doesn't in saturated one this tells us

247
00:10:00,340 --> 00:09:58,550
that in the saturated one the perma the

248
00:10:02,019 --> 00:10:00,350
methane that's down in the subsurface is

249
00:10:04,990 --> 00:10:02,029
diffusion limited in reaching the

250
00:10:07,810 --> 00:10:05,000
headspace but if we look at the

251
00:10:09,730 --> 00:10:07,820
unsaturated one we see that it's not and

252
00:10:11,920 --> 00:10:09,740
this should have represented a very

253
00:10:13,269 --> 00:10:11,930
large increase in the methane flux

254
00:10:15,250 --> 00:10:13,279
during this thought period there should

255
00:10:16,600 --> 00:10:15,260
have been a large bolus of methane that

256
00:10:18,640 --> 00:10:16,610
reach the surface and we just didn't see

257
00:10:21,550 --> 00:10:18,650
it so we're trying to identify what's

258
00:10:23,079 --> 00:10:21,560
actually going on here in this thing yes

259
00:10:27,400 --> 00:10:23,089
we just have a mass balance issue in

260
00:10:28,300 --> 00:10:27,410
terms of where this methane is and if we

261
00:10:30,010 --> 00:10:28,310
look at this data in a slightly

262
00:10:33,850 --> 00:10:30,020
different way here's that same data just

263
00:10:35,320 --> 00:10:33,860

shown a little different if we start

264
00:10:36,850 --> 00:10:35,330
running it out and putting methane

265
00:10:38,530 --> 00:10:36,860
actually into the headspace we see that

266
00:10:40,360 --> 00:10:38,540
rather than these soils being a source

267
00:10:43,030 --> 00:10:40,370
of methane so we were imagining this

268
00:10:45,100 --> 00:10:43,040
would be large meth anak with antigen at

269
00:10:46,990 --> 00:10:45,110
community there we actually see that we

270
00:10:49,329 --> 00:10:47,000
have methane atrophic curring in all

271
00:10:50,650 --> 00:10:49,339
cores in all treatments so mainly thing

272
00:10:52,030 --> 00:10:50,660
about this in terms of saturated and

273
00:10:54,190 --> 00:10:52,040
everything else everything else gets

274
00:10:55,990 --> 00:10:54,200
access to some oxygen saturated is

275
00:10:58,900 --> 00:10:56,000
diffusion limited by the water that's

276
00:11:01,930 --> 00:10:58,910
presents on the cores and what we can

277
00:11:04,240 --> 00:11:01,940
see is that there's actually even in

278
00:11:06,699 --> 00:11:04,250
saturated cores methane oxidation is

279
00:11:08,620 --> 00:11:06,709
occurring and we can tell it this is not

280
00:11:10,030 --> 00:11:08,630
due to residual oxygen we can look at

281
00:11:12,370 --> 00:11:10,040
oxygen this present the pore water and

282
00:11:13,570 --> 00:11:12,380
see that this is some sort of non

283
00:11:16,000 --> 00:11:13,580
oxygenic

284
00:11:19,540 --> 00:11:16,010
or aerobic methane oxidation which is

285
00:11:21,580 --> 00:11:19,550
very interesting so I'll skip over this

286
00:11:23,020 --> 00:11:21,590
we've looked we did some microcosm work

287
00:11:25,840 --> 00:11:23,030
to try to determine what's actually

288
00:11:27,670 --> 00:11:25,850

happening in terms of methane production

289
00:11:29,470 --> 00:11:27,680
and consumption at various steps and it

290
00:11:32,560 --> 00:11:29,480
various temperatures throughout the

291
00:11:36,250 --> 00:11:32,570
profile in these cores and what we use

292
00:11:38,410 --> 00:11:36,260
this for was to develop a 2d model for

293
00:11:40,750 --> 00:11:38,420
methane production flux so this is a

294
00:11:45,310 --> 00:11:40,760
couple biology and physics model that

295
00:11:48,580 --> 00:11:45,320
we've made that also uses a ph

296
00:11:51,250 --> 00:11:48,590
dependence equation to model methane

297
00:11:52,450 --> 00:11:51,260
methane a trophy methanogenesis and it's

298
00:11:54,070 --> 00:11:52,460
also linked to temperature by the

299
00:11:55,660 --> 00:11:54,080
Iranians equation which is what are

300
00:11:57,400 --> 00:11:55,670
microcosms were used to do sorry I

301
00:11:59,320 --> 00:11:57,410
skipped over that a little bit but we're

302
00:12:00,760 --> 00:11:59,330
able to make predictions about methane

303
00:12:04,330 --> 00:12:00,770
consumption and production in these

304
00:12:06,970 --> 00:12:04,340
environments based on empirical evidence

305
00:12:11,230 --> 00:12:06,980
that we have so we've generated in our

306
00:12:12,850 --> 00:12:11,240
own model for doing this kind of work so

307
00:12:14,830 --> 00:12:12,860
far we're very good at being able to

308
00:12:17,760 --> 00:12:14,840
predict what happens in unsaturated

309
00:12:20,170 --> 00:12:17,770
soils we have a bit of an issue still

310
00:12:22,750 --> 00:12:20,180
recreating what our fluxes should look

311
00:12:24,010 --> 00:12:22,760
like in terms of the saturated soils we

312
00:12:28,270 --> 00:12:24,020
think this might be due to the fact that

313
00:12:30,520 --> 00:12:28,280

we have an me going on so la slit up the

314
00:12:32,170 --> 00:12:30,530
side there there's some interesting

315
00:12:34,990 --> 00:12:32,180
papers that have that show that there's

316
00:12:37,180 --> 00:12:35,000
this potential coupling between sulfate

317
00:12:39,670 --> 00:12:37,190
reduction and methane oxidation that

318
00:12:41,740 --> 00:12:39,680
occurs in certain soils and we see

319
00:12:44,710 --> 00:12:41,750
evidence of sulfate reduction in our

320
00:12:47,080 --> 00:12:44,720
soils which may be indicative of this so

321
00:12:48,550 --> 00:12:47,090
sort of just a quick summary we've

322
00:12:51,040 --> 00:12:48,560
developed a 2d model looking at methane

323
00:12:52,870 --> 00:12:51,050
cycle in the Arctic we see a nice cycle

324
00:12:55,450 --> 00:12:52,880
that occurs within the permafrost in the

325
00:12:57,700 --> 00:12:55,460
active layer within a link system so

326
00:12:59,830 --> 00:12:57,710
it's not distal in terms of production

327
00:13:01,300 --> 00:12:59,840
and consumption we see the production or

328
00:13:03,250 --> 00:13:01,310
potential for an aerobic oxidation of

329
00:13:05,680 --> 00:13:03,260
methane in saturated soils and we have

330
00:13:07,060 --> 00:13:05,690
some future work incorporating the model

331
00:13:09,820 --> 00:13:07,070
with some more things and doing tracer

332
00:13:12,610 --> 00:13:09,830
experiments to look at a gentleman

333
00:13:19,500 --> 00:13:12,620
connectivity between methane oxidation

334
00:13:37,300 --> 00:13:32,820
Thank You Brandon any questions sure I'm

335
00:13:40,000 --> 00:13:37,310
so I for a lot of these guys as long as

336
00:13:41,320 --> 00:13:40,010
they're able to as long as the system

337
00:13:42,400 --> 00:13:41,330
isn't completely closed you get some

338
00:13:44,850 --> 00:13:42,410

cracks in the system they're able to get

339
00:13:47,140 --> 00:13:44,860
fresh oxidants and they can turn over I

340
00:13:50,560 --> 00:13:47,150
turn over their DNA and do some DNA

341
00:13:51,880 --> 00:13:50,570
repair there's not a good reason that

342
00:13:53,710 --> 00:13:51,890
they can't exist for thousands and

343
00:13:56,170 --> 00:13:53,720
thousands of years in the permafrost on

344
00:13:59,110 --> 00:13:56,180
the adjusting to be able to have a

345
00:14:02,800 --> 00:13:59,120
minimum minimum energetic requirement

346
00:14:04,150 --> 00:14:02,810
met in order to do that base repair so

347
00:14:09,880 --> 00:14:04,160
they can last quite a long time down

348
00:14:11,410 --> 00:14:09,890
there do you have any 16s station yet

349
00:14:13,810 --> 00:14:11,420
for what's going on in those communities

350
00:14:16,660 --> 00:14:13,820
so we're still waiting on it I'm talking

351
00:14:18,760 --> 00:14:16,670
you repeat that do you have any 16s rrna

352
00:14:20,290 --> 00:14:18,770
gene profiles for the communities and

353
00:14:22,870 --> 00:14:20,300
these cores are you still waiting on

354
00:14:25,570 --> 00:14:22,880
that data yes so they're about 1%

355
00:14:27,820 --> 00:14:25,580
archaea in terms of what's going on so

356
00:14:29,470 --> 00:14:27,830
there's a fairly low presumably

357
00:14:31,240 --> 00:14:29,480
methanogenic community that's going on

358
00:14:34,270 --> 00:14:31,250
there and they're primarily focused in

359
00:14:35,590 --> 00:14:34,280
about 65 centimetres or below um we've

360
00:14:40,270 --> 00:14:35,600
gotten some stuff back looking at the

361
00:14:42,490 --> 00:14:40,280
top 35 centimeters we see about 1% alpha

362
00:14:45,250 --> 00:14:42,500
proteobacteria that should be methane

363
00:14:51,130 --> 00:14:45,260

atrophic communities pipe to meth anna

364
00:14:53,410 --> 00:14:51,140
caucus um or middle of caucus I we're

365
00:14:55,180 --> 00:14:53,420
still doing work and looking at what the

366
00:14:57,040 --> 00:14:55,190
changes over time we'd like to see a

367
00:14:58,690 --> 00:14:57,050
difference in the profiles as thaw goes

368
00:15:13,280 --> 00:14:58,700
on but we're still waiting on getting

369
00:15:19,500 --> 00:15:16,079
do you plan to screen any of the

370
00:15:22,230 --> 00:15:19,510
permafrost I slits at marsh and

371
00:15:25,139 --> 00:15:22,240
conditions and I asked that because we

372
00:15:27,090 --> 00:15:25,149
my lab recently got a I slit from

373
00:15:28,590 --> 00:15:27,100
permafrost in Russia that grows up

374
00:15:30,480 --> 00:15:28,600
marketing conditions so you might have

375
00:15:32,850 --> 00:15:30,490
something exciting in your permafrost

376
00:15:37,880 --> 00:15:32,860
that would be awesome might uh I'd love

377
00:15:44,819 --> 00:15:37,890
to do it if you have any money for me to

378
00:15:46,050 --> 00:15:44,829
i'll be taking checks cash hey um so

379
00:15:49,170 --> 00:15:46,060
essentially you just showed that you

380
00:15:51,480 --> 00:15:49,180
have a methane sink in fine permafrost

381
00:15:53,190 --> 00:15:51,490
um and so I know this is an astrobiology

382
00:15:56,519 --> 00:15:53,200
conference but would you care to comment

383
00:15:58,620 --> 00:15:56,529
on the inevitable conclusions that

384
00:16:00,389 --> 00:15:58,630
people will make that with global

385
00:16:01,829 --> 00:16:00,399
warming and your permafrost laws that

386
00:16:05,160 --> 00:16:01,839
this might actually solve all of our

387
00:16:08,009 --> 00:16:05,170
problems um yeah so this actually

388
00:16:11,100 --> 00:16:08,019

presents a really unique environment to

389
00:16:13,530 --> 00:16:11,110
look at this kind of thing I where it's

390
00:16:14,730 --> 00:16:13,540
a low organic carbon soil which is very

391
00:16:16,680 --> 00:16:14,740
different than a lot of the research

392
00:16:18,750 --> 00:16:16,690
that's done in terms of methane release

393
00:16:20,430 --> 00:16:18,760
into the environment those happen to be

394
00:16:22,769 --> 00:16:20,440
those are usually done in very high

395
00:16:24,329 --> 00:16:22,779
organic carbon content like peat bogs

396
00:16:27,960 --> 00:16:24,339
that kind of stuff where you see twenty

397
00:16:29,220 --> 00:16:27,970
thirty forty percent organic carbon we

398
00:16:31,199 --> 00:16:29,230
have a really hard time here actually

399
00:16:33,660 --> 00:16:31,209
turning on our math Anna genet community

400
00:16:35,699 --> 00:16:33,670
we feed em acetate we feed mhm to co2

401
00:16:38,160 --> 00:16:35,709
they don't seem to really like it and

402
00:16:39,870 --> 00:16:38,170
our methane agentur meth inotropes super

403
00:16:42,269 --> 00:16:39,880
happy to eat any methane that we do give

404
00:16:44,699 --> 00:16:42,279
them so this might be indicative of

405
00:16:46,500 --> 00:16:44,709
types of soil organic carbon a little

406
00:16:48,900 --> 00:16:46,510
bit drier where we've just sort of

407
00:16:51,540 --> 00:16:48,910
crossed some sort of threshold and they

408
00:16:53,579 --> 00:16:51,550
turn into sinks as opposed to sources um

409
00:16:56,340 --> 00:16:53,589
I think it depends on what the

410
00:16:59,220 --> 00:16:56,350
distribution is but areas like this look