Nicole Wagner

Metagenomic Analysis of the Methane-Rich Anoxic Basin of Lake Untersee

1
00:00:00,240 --> 00:00:10,839
[Music]

2
00:00:15,289 --> 00:00:13,640
hi everyone I am the call from

3
00:00:17,240 --> 00:00:15,299
Georgetown and I'm going to be talking

4
00:00:20,990 --> 00:00:17,250
to you about the betta genomics epi

5
00:00:23,480 --> 00:00:21,000
anoxic basin of Lake Untersee so today

6
00:00:25,520 --> 00:00:23,490
I'm just gonna go over the relevance of

7
00:00:27,650 --> 00:00:25,530
and how analog environments and talk

8
00:00:30,410 --> 00:00:27,660
about my samples and how they were

9
00:00:34,520 --> 00:00:30,420
prepped what results I got and future

10
00:00:36,189 --> 00:00:34,530
work so so there are a lot of new

11
00:00:38,900 --> 00:00:36,199
propulsion systems being made currently

12
00:00:40,220 --> 00:00:38,910
frankly not work drive but still really

13
00:00:43,189 --> 00:00:40,230

cool and they're gonna take us farther

14
00:00:44,799 --> 00:00:43,199
than ever before and faster and now

15
00:00:48,259 --> 00:00:44,809
we're gonna have all these explorers

16
00:00:50,299 --> 00:00:48,269
organic robotic going these places so we

17
00:00:51,889 --> 00:00:50,309
need them to have a roadmap of what to

18
00:00:53,599 --> 00:00:51,899
look for we don't really want them to

19
00:00:56,840 --> 00:00:53,609
have a preconceived notion of what life

20
00:00:59,139 --> 00:00:56,850
is but they need some kind of plan so

21
00:01:01,969 --> 00:00:59,149
how do we figure out what they should do

22
00:01:03,799 --> 00:01:01,979
we study analog environments and analog

23
00:01:06,020 --> 00:01:03,809
environments are extreme environments

24
00:01:08,180 --> 00:01:06,030
here on earth with conditions that are

25
00:01:12,620 --> 00:01:08,190
really hospitable to life as we know it

26
00:01:16,220 --> 00:01:12,630
and some of them are D Antarctic Dry

27
00:01:17,810 --> 00:01:16,230
Valleys good analog for Mars and hard to

28
00:01:18,980 --> 00:01:17,820
go they contour Siegen analog protion

29
00:01:21,520 --> 00:01:18,990
worlds we'll talk about that later

30
00:01:24,860 --> 00:01:21,530
craters of the moon good analog for

31
00:01:28,910 --> 00:01:24,870
craters or lava tubes under the Martian

32
00:01:30,560 --> 00:01:28,920
surface so why study them well we're

33
00:01:32,570 --> 00:01:30,570
kind of stuck on earth so we don't have

34
00:01:34,310 --> 00:01:32,580
a lot of options one of them would be

35
00:01:36,800 --> 00:01:34,320
computer simulations or we could

36
00:01:38,860 --> 00:01:36,810
simulate these environments in a

37
00:01:42,590 --> 00:01:38,870
laboratory or we could go out and

38
00:01:45,770 --> 00:01:42,600

actually find extreme environments that

39
00:01:48,860 --> 00:01:45,780
are taking a few liberties similar to

40
00:01:50,810 --> 00:01:48,870
those of other worlds if life can

41
00:01:52,340 --> 00:01:50,820
survive in these places we get to learn

42
00:01:53,420 --> 00:01:52,350
about them we get to learn how they

43
00:01:58,340 --> 00:01:53,430
survive in these extreme environments

44
00:02:01,820 --> 00:01:58,350
and that helps us broaden the definition

45
00:02:05,240 --> 00:02:01,830
of habitable get talk to you a little

46
00:02:06,260 --> 00:02:05,250
bit about my extreme environment which

47
00:02:09,229 --> 00:02:06,270
is Lake Untersee

48
00:02:11,390 --> 00:02:09,239
and it is located in Antarctica it's

49
00:02:13,130 --> 00:02:11,400
always covered in ice three to five

50
00:02:14,930 --> 00:02:13,140
meters all year long

51
00:02:18,200 --> 00:02:14,940
and it's closed off from the environment

52
00:02:21,020 --> 00:02:18,210
almost no external nutrient flow and as

53
00:02:23,510 --> 00:02:21,030
it is in Antarctica it is covered in

54
00:02:25,490 --> 00:02:23,520
darkness six months of the year and only

55
00:02:28,160 --> 00:02:25,500
simple organisms have been found here

56
00:02:31,280 --> 00:02:28,170
only prokaryotes and viruses and no use

57
00:02:34,070 --> 00:02:31,290
so far but that's not the only

58
00:02:34,730 --> 00:02:34,080
interesting thing about it it has two

59
00:02:36,980 --> 00:02:34,740
basins

60
00:02:40,340 --> 00:02:36,990
it has aerobic basin and the anoxic

61
00:02:43,130 --> 00:02:40,350
Basin jariabek Basin is deeper than

62
00:02:45,320 --> 00:02:43,140
anoxic Basin near the glacier and it is

63
00:02:48,320 --> 00:02:45,330

completely homogeneous well mixed and it

64
00:02:50,270 --> 00:02:48,330
has oxygen in it the top 60 so if you

65
00:02:53,630 --> 00:02:50,280
look at this one the Green Line about

66
00:02:56,120 --> 00:02:53,640
the top 60 meters of the anoxic Basin is

67
00:02:57,770 --> 00:02:56,130
similar to the aerobic Mason well mixed

68
00:03:00,500 --> 00:02:57,780
and then there is about a 10 meter

69
00:03:03,350 --> 00:03:00,510
OxiClean where the oxygen suddenly drops

70
00:03:07,190 --> 00:03:03,360
to zero and then we have this little 20

71
00:03:12,440 --> 00:03:07,200
meter pocket of completely stratified

72
00:03:15,560 --> 00:03:12,450
anoxic water but it also happens to be

73
00:03:17,479 --> 00:03:15,570
so this 20 meter pocket also happens to

74
00:03:19,670 --> 00:03:17,489
be a low pocket of methane and has one

75
00:03:21,470 --> 00:03:19,680
of the highest methane concentrations on

76
00:03:25,060 --> 00:03:21,480
earth and since there is no methane seep

77
00:03:28,370 --> 00:03:25,070
it is believed to be a biotic of origin

78
00:03:30,170 --> 00:03:28,380
so that was all good but now we're going

79
00:03:34,280 --> 00:03:30,180
to talk about what's really important

80
00:03:36,560 --> 00:03:34,290
here that's me so I talked about these

81
00:03:39,949 --> 00:03:36,570
intrepid explorers earlier it so happens

82
00:03:41,690 --> 00:03:39,959
that I myself and one of them last fall

83
00:03:45,289 --> 00:03:41,700
I made the artist director Antarctica

84
00:03:49,009 --> 00:03:45,299
and a very little-known vessel known as

85
00:03:50,650 --> 00:03:49,019
the Boeing set at 370 737 I know you

86
00:03:55,910 --> 00:03:50,660
haven't heard of it don't don't worry

87
00:03:57,920 --> 00:03:55,920
it's very specialized um so I collected

88
00:03:59,539 --> 00:03:57,930

samples with a creamy bit of help from

89
00:04:01,520 --> 00:03:59,549
the anoxic Basin

90
00:04:02,509 --> 00:04:01,530
so we used a Miskin bottle we can talk

91
00:04:04,940 --> 00:04:02,519
about what that is later if you're

92
00:04:07,910 --> 00:04:04,950
interested collected samples from the

93
00:04:10,069 --> 00:04:07,920
bottom of the oxy klein 75 meters as

94
00:04:12,080 --> 00:04:10,079
well as two locations within the anoxic

95
00:04:14,060 --> 00:04:12,090
zone ninety two meter ninety nine meter

96
00:04:17,870 --> 00:04:14,070
because it is stratified so I want to

97
00:04:20,330 --> 00:04:17,880
look at more than one depth then I used

98
00:04:22,730 --> 00:04:20,340
a concentrating pipette which is this

99
00:04:25,219 --> 00:04:22,740
really cool device that sucks up water

100
00:04:26,900 --> 00:04:25,229
with this little straw like filter is a

101
00:04:29,060 --> 00:04:26,910
whole of fiber filter comes in

102
00:04:31,550 --> 00:04:29,070
in sizes and then use as a solution

103
00:04:34,400 --> 00:04:31,560
buffer to elute whatever gets stuck in

104
00:04:38,090 --> 00:04:34,410
this filter and whatever water is

105
00:04:39,890 --> 00:04:38,100
filtered out goes out so we use a point

106
00:04:41,750 --> 00:04:39,900
four or five micron filter initially

107
00:04:43,850 --> 00:04:41,760
because we wanted to catch any sediments

108
00:04:45,560 --> 00:04:43,860
or over larger organisms the filtrate we

109
00:04:48,140 --> 00:04:45,570
ran three point zero five micron filter

110
00:04:49,640 --> 00:04:48,150
because we wanted to catch any bacteria

111
00:04:52,040 --> 00:04:49,650
phages that could be present or smaller

112
00:04:54,860 --> 00:04:52,050
organisms and then we saved all of this

113
00:04:56,750 --> 00:04:54,870

in a liquid nitrogen pine cry shipper or

114
00:04:59,030 --> 00:04:56,760
at least that's what I wish I had done

115
00:05:02,030 --> 00:04:59,040
because this guy is not meant for

116
00:05:04,820 --> 00:05:02,040
Antarctica the inner fluidics freeze and

117
00:05:06,620 --> 00:05:04,830
it pops a tube and it's useless and some

118
00:05:08,330 --> 00:05:06,630
of us don't have very good foresight and

119
00:05:12,140 --> 00:05:08,340
don't pack a lot of other filters with

120
00:05:17,660 --> 00:05:12,150
them so we end up bringing water back

121
00:05:20,150 --> 00:05:17,670
from Antarctica naaku which meant I only

122
00:05:22,520 --> 00:05:20,160
had about 200 milliliters of water to

123
00:05:24,650 --> 00:05:22,530
concentrate cells from and that gave me

124
00:05:27,320 --> 00:05:24,660
a really hard time because that's

125
00:05:29,320 --> 00:05:27,330
extremely low biomass and I had to try a

126
00:05:32,420 --> 00:05:29,330
bunch of different kinds of extractions

127
00:05:34,820 --> 00:05:32,430
so I think and as I've talked about this

128
00:05:37,310 --> 00:05:34,830
a lot really well

129
00:05:40,160 --> 00:05:37,320
so we tried a bunch of different forms

130
00:05:42,380 --> 00:05:40,170
of lysis so breaking down the cells we

131
00:05:44,510 --> 00:05:42,390
just beat beated it shook it really

132
00:05:47,840 --> 00:05:44,520
really hard in some soap with a bunch of

133
00:05:49,400 --> 00:05:47,850
beet and or used like lytic enzymes to

134
00:05:51,860 --> 00:05:49,410
break open the cells and use a bunch of

135
00:05:52,940 --> 00:05:51,870
different kits modified with modified

136
00:05:55,490 --> 00:05:52,950
protocols that are currently in the

137
00:05:57,830 --> 00:05:55,500
market and we finally got enough DNA

138
00:05:59,990 --> 00:05:57,840

just enough to be able to sequence it

139
00:06:02,420 --> 00:06:00,000
with this new Swift Wynette's kit which

140
00:06:06,260 --> 00:06:02,430
is a kid for library prep using alumina

141
00:06:09,470 --> 00:06:06,270
and it works with as little as ten

142
00:06:11,540 --> 00:06:09,480
picograms of DNA and it also works when

143
00:06:14,720 --> 00:06:11,550
it nicked or damaged DNA so real cool

144
00:06:18,020 --> 00:06:14,730
didn't got the sequences back and all

145
00:06:20,660 --> 00:06:18,030
these tiny a 150 base Bayer AG seasoned

146
00:06:22,730 --> 00:06:20,670
T's put them together had longer jg

147
00:06:25,610 --> 00:06:22,740
seasoned teeth and then I had a big fat

148
00:06:30,220 --> 00:06:25,620
community of a puzzle makes that puzzle

149
00:06:33,800 --> 00:06:30,230
so started looking into that results

150
00:06:35,750 --> 00:06:33,810
first thing was looking in so you like

151
00:06:39,030 --> 00:06:35,760
seeing what what was there actually I

152
00:06:42,060 --> 00:06:39,040
hope you're all enough for that

153
00:06:44,060 --> 00:06:42,070
so few cool things here we have freddiew

154
00:06:47,130 --> 00:06:44,070
bacteria these green ones are to produce

155
00:06:49,320 --> 00:06:47,140
we have a lot of firmicutes Bacteroides

156
00:06:53,700 --> 00:06:49,330
but these little pink ones are purple

157
00:06:55,380 --> 00:06:53,710
ones are URI archaea and your your Kyoto

158
00:06:57,600 --> 00:06:55,390
really are really cool because as you

159
00:07:00,990 --> 00:06:57,610
recall this is a anoxic methanogenic um

160
00:07:04,980 --> 00:07:01,000
basin and URIs are known for having some

161
00:07:06,600 --> 00:07:04,990
of the most managed ins within them so

162
00:07:08,850 --> 00:07:06,610
if I hadn't found something like this I

163
00:07:12,660 --> 00:07:08,860

would have been disappointed to say the

164
00:07:16,580 --> 00:07:12,670
least so I looked more closely at the

165
00:07:20,100 --> 00:07:16,590
URIs and Wow look at all the unknowns

166
00:07:22,950 --> 00:07:20,110
now what does that mean well that means

167
00:07:26,430 --> 00:07:22,960
I get to broaden the branches of the

168
00:07:31,020 --> 00:07:26,440
tree of life I get to write a lot of 500

169
00:07:33,180 --> 00:07:31,030
more genome announcement papers so also

170
00:07:35,520 --> 00:07:33,190
this is going to shock you so please

171
00:07:39,270 --> 00:07:35,530
please contain yourselves we have this

172
00:07:40,440 --> 00:07:39,280
myth a no methane-rich anoxic water with

173
00:07:42,870 --> 00:07:40,450
a lot of methanogens

174
00:07:45,000 --> 00:07:42,880
and I found a complete myth antigenic

175
00:07:50,250 --> 00:07:45,010
pathway there is methane being made

176
00:07:52,470 --> 00:07:50,260
biotic Lee I'm shocked so but we have

177
00:07:54,900 --> 00:07:52,480
other organisms other organisms that

178
00:07:56,909 --> 00:07:54,910
methanogens we also have bacteria which

179
00:07:58,860 --> 00:07:56,919
does new mechanic genesis so there has

180
00:08:00,150 --> 00:07:58,870
to be something else happening according

181
00:08:02,460 --> 00:08:00,160
to literature der a lot of sulfur

182
00:08:07,070 --> 00:08:02,470
compounds in the anoxic basin so the

183
00:08:09,930 --> 00:08:07,080
natural conclusion is sulfate reduction

184
00:08:13,200 --> 00:08:09,940
so sulfate reduction is happening and

185
00:08:15,180 --> 00:08:13,210
both the anoxic basin and sorry in both

186
00:08:20,600 --> 00:08:15,190
the OxiClean region and the anoxic

187
00:08:23,010 --> 00:08:20,610
region and as you perhaps recall we had

188
00:08:24,780 --> 00:08:23,020

proteobacteria announcer as well as

189
00:08:26,090 --> 00:08:24,790
Firmicutes and deltas that are part of

190
00:08:31,170 --> 00:08:26,100
the produ bacterial phylum Firmicutes

191
00:08:34,310 --> 00:08:31,180
have the two largest groups of sulfate

192
00:08:36,450 --> 00:08:34,320
reducers with into bacterial domain so

193
00:08:37,860 --> 00:08:36,460
these are two ways that they're making a

194
00:08:39,899 --> 00:08:37,870
living there are definitely other ways

195
00:08:43,680 --> 00:08:39,909
and I will look into those later because

196
00:08:45,930 --> 00:08:43,690
I don't really have time and future work

197
00:08:49,260 --> 00:08:45,940
because if there is new future work I'll

198
00:08:51,800 --> 00:08:49,270
be out of a job looking for mags the

199
00:08:54,050 --> 00:08:51,810
meta-genome assembled genomes so

200
00:08:55,910 --> 00:08:54,060
that whole big puzzle I try to put

201
00:08:58,370 --> 00:08:55,920
little pieces of puzzle together dad

202
00:09:00,260 --> 00:08:58,380
belong to the same organism that's a

203
00:09:00,790 --> 00:09:00,270
much better than what I had thank you

204
00:09:04,880 --> 00:09:00,800
for that

205
00:09:06,590 --> 00:09:04,890
so yes again as a lot of branch of the

206
00:09:09,320 --> 00:09:06,600
Tree of Life I had a lot of lines to my

207
00:09:10,820 --> 00:09:09,330
upper CV so that's great I need are any

208
00:09:13,840 --> 00:09:10,830
working transcriptome aches but since my

209
00:09:15,710 --> 00:09:13,850
samples were not very well preserved

210
00:09:20,060 --> 00:09:15,720
that's probably not going to happen

211
00:09:23,420 --> 00:09:20,070
until I get new samples or you or I talk

212
00:09:25,820 --> 00:09:23,430
to some RNA specialists so if you even

213
00:09:27,220 --> 00:09:25,830

work a lot with RNA please please help

214
00:09:30,829 --> 00:09:27,230
me

215
00:09:32,780 --> 00:09:30,839
also there is I collected samples from

216
00:09:33,920 --> 00:09:32,790
the sediment the benthic sediments and I

217
00:09:36,050 --> 00:09:33,930
think it's going to be super cool to

218
00:09:37,310 --> 00:09:36,060
study how their sediment the sediments

219
00:09:39,920 --> 00:09:37,320
which are actually quite rich in

220
00:09:43,340 --> 00:09:39,930
organisms are going to interact with the

221
00:09:48,190 --> 00:09:43,350
water and what that exactly does so that

222
00:09:50,750 --> 00:09:48,200
will be cool to study and that's all

223
00:09:53,290 --> 00:09:50,760
thank you to the people in a bowl to

224
00:09:56,120 --> 00:09:53,300
help me with the science and with the

225
00:09:59,090 --> 00:09:56,130
sample collection and everybody else for

226
00:10:01,250 --> 00:09:59,100
their emotional supports because I'm

227
00:10:03,890 --> 00:10:01,260
quite a handful thanks to t'lani

228
00:10:06,079 --> 00:10:03,900
is study for sending me to Antarctica

229
00:10:08,510 --> 00:10:06,089
NASA for helping me do all of that and

230
00:10:10,190 --> 00:10:08,520
the Johnson my signatures are obviously

231
00:10:14,820 --> 00:10:10,200
for giving me a desk and a promise at

232
00:10:27,460 --> 00:10:14,830
the PhD and I made that myself thank you

233
00:10:31,730 --> 00:10:28,820
Hey

234
00:10:33,650 --> 00:10:31,740
so cool talk I'm interested though for

235
00:10:35,540 --> 00:10:33,660
your metagenomics work how did you do

236
00:10:36,440 --> 00:10:35,550
your tax on bidding I don't know who to

237
00:10:40,790 --> 00:10:36,450
look at Hey

238
00:10:42,710 --> 00:10:40,800

oh hi how did you do you're a taxonomic

239
00:10:47,540 --> 00:10:42,720
profiling how did I do my taxonomic

240
00:10:48,680 --> 00:10:47,550
profiling so we used meta pathways I

241
00:10:51,920 --> 00:10:48,690
don't know if you're similar with it or

242
00:10:54,320 --> 00:10:51,930
not so many pathways did an annotation

243
00:10:56,030 --> 00:10:54,330
against the refseq database and I used

244
00:10:58,870 --> 00:10:56,040
40 marker genes which all belong to the

245
00:11:02,660 --> 00:10:58,880
ribosome which were found within

246
00:11:04,760 --> 00:11:02,670
meta-genome and it gave me a list of

247
00:11:06,680 --> 00:11:04,770
organisms that they had the best match

248
00:11:09,260 --> 00:11:06,690
to now this is more accurate than doing

249
00:11:10,519 --> 00:11:09,270
a 16s because in addition to 16s it used

250
00:11:12,890 --> 00:11:10,529
a lot of other genes that are also

251
00:11:17,870 --> 00:11:12,900
present in ribosomes and tyrannies as

252
00:11:19,579 --> 00:11:17,880
well is there any evidence for with an

253
00:11:20,720 --> 00:11:19,589
atrophic life that could be redox couple

254
00:11:22,579 --> 00:11:20,730
to the sulfate reduction

255
00:11:25,010 --> 00:11:22,589
you know I am definitely looking for

256
00:11:26,240 --> 00:11:25,020
that that is something that I am also

257
00:11:28,120 --> 00:11:26,250
interested in because there's all this

258
00:11:30,170 --> 00:11:28,130
methane there's all this uneaten lunch

259
00:11:32,870 --> 00:11:30,180
that I want to know if it's being used

260
00:11:34,010 --> 00:11:32,880
so that is the one of the next steps as

261
00:11:36,050 --> 00:11:34,020
well as I want to look at all these

262
00:11:37,430 --> 00:11:36,060
managing of assembled genomes to see if

263
00:11:45,230 --> 00:11:37,440

there are any known miss Ana tropes

264
00:11:50,040 --> 00:11:47,880
how are you how are you gonna come up

265
00:11:52,680 --> 00:11:50,050
with a whole bunch of species names I

266
00:11:56,790 --> 00:11:52,690
see you know I just recently published

267
00:11:58,350 --> 00:11:56,800
one and if I wished it and um this I

268
00:12:00,150 --> 00:11:58,360
don't I'm forgetting the name of the

269
00:12:02,370 --> 00:12:00,160
journal shouldn't say they don't let you

270
00:12:04,170 --> 00:12:02,380
name it but if you find my genome

271
00:12:06,449 --> 00:12:04,180
announcement paper I'm calling it

272
00:12:12,780 --> 00:12:06,459
mechanic laziest Untersee on says so

273
00:12:14,880 --> 00:12:12,790
call it that I'm gonna ask a question

274
00:12:17,490 --> 00:12:14,890
I'd abused my Mike powers

275
00:12:20,430 --> 00:12:17,500
uh did you find any evidence for

276
00:12:22,650 --> 00:12:20,440
anaerobic oxidation of methane or anomie

277
00:12:24,449 --> 00:12:22,660
or something like so honestly I haven't

278
00:12:25,920 --> 00:12:24,459
looked very closely at him he asked if I

279
00:12:27,860 --> 00:12:25,930
just recently got the data back a few