Adrian Barry-Sosa

Greenhouse Gases as Potential Biomarkers for Microbial Activity in Underground Environments

1
00:00:00,240 --> 00:00:10,869
[Music]

2
00:00:15,409 --> 00:00:13,759
in this talk I'm gonna present about the

3
00:00:18,110 --> 00:00:15,419
early findings of a collaborative

4
00:00:20,420 --> 00:00:18,120
research done between my department the

5
00:00:22,370 --> 00:00:20,430
Department of Microbiology analysis and

6
00:00:24,410 --> 00:00:22,380
the department of geological science

7
00:00:29,030 --> 00:00:24,420
both of us working in the university

8
00:00:32,060 --> 00:00:29,040
Florida so what system are we working

9
00:00:34,759 --> 00:00:32,070
we're working a system called the upper

10
00:00:37,700 --> 00:00:34,769
florian aquifer and the upper florian

11
00:00:40,009 --> 00:00:37,710
aquifer or UFA for shirt is yes an

12
00:00:40,970 --> 00:00:40,019
aquifer so now then the next question

13
00:00:45,979 --> 00:00:40,980

what

14
00:00:48,860 --> 00:00:45,989
hydrological formation that contains

15
00:00:52,669 --> 00:00:48,870
water within it pretty much like a

16
00:00:55,639 --> 00:00:52,679
sponge in the case of the you FLE this

17
00:00:57,439 --> 00:00:55,649
aquifer is a karstic aquifer and by

18
00:01:00,500 --> 00:00:57,449
karthik i mean that the rock that

19
00:01:02,540 --> 00:01:00,510
contains the water is limestone and in

20
00:01:05,000 --> 00:01:02,550
fact limestone formations as you can see

21
00:01:07,910 --> 00:01:05,010
in this map are widespread across the

22
00:01:08,540 --> 00:01:07,920
globe they cover around 20% of Earth's

23
00:01:11,000 --> 00:01:08,550
surface

24
00:01:14,150 --> 00:01:11,010
and in fact in the case of florida they

25
00:01:15,880 --> 00:01:14,160
the ufa extend pretty much through the

26
00:01:19,970 --> 00:01:15,890
whole peninsulas well some parts of

27
00:01:23,300 --> 00:01:19,980
South Georgia and Alabama now the deal

28
00:01:24,920 --> 00:01:23,310
here is that this aquifer is what's

29
00:01:27,350 --> 00:01:24,930
called a confined aquifer meaning that

30
00:01:29,510 --> 00:01:27,360
there is a layer of rock on top of the

31
00:01:31,430 --> 00:01:29,520
rock that contains water that is

32
00:01:34,600 --> 00:01:31,440
impermeable doesn't allow the water to

33
00:01:37,820 --> 00:01:34,610
go through whoever in some parts namely

34
00:01:40,370 --> 00:01:37,830
North Central Florida this top confining

35
00:01:42,500 --> 00:01:40,380
unit has been removed by erosion and -

36
00:01:44,510 --> 00:01:42,510
and that's not a surprise that all the

37
00:01:48,800 --> 00:01:44,520
six prints though we have simple are

38
00:01:50,870 --> 00:01:48,810

located in that uncle finery now you

39
00:01:53,510 --> 00:01:50,880
might be asking yourself okay you have

40
00:01:55,940 --> 00:01:53,520
this cool system but why is it relevant

41
00:01:59,030 --> 00:01:55,950
for us to biology because we are in an

42
00:02:03,620 --> 00:01:59,040
astrobiology conference so there are

43
00:02:05,150 --> 00:02:03,630
many points that I can talk to you about

44
00:02:06,860 --> 00:02:05,160
this aquifer and whites rallying for

45
00:02:10,279 --> 00:02:06,870
astrobiology here are the main ones

46
00:02:13,620 --> 00:02:10,289
first of all this aquifer is limited in

47
00:02:15,000 --> 00:02:13,630
any surface inputs there

48
00:02:18,090 --> 00:02:15,010
one of the aquifers that we believe

49
00:02:20,910 --> 00:02:18,100
they're completely shielded from input

50
00:02:24,630 --> 00:02:20,920
from the surface meaning that these

51
00:02:29,250 --> 00:02:24,640
specific points are low energy systems

52
00:02:33,000 --> 00:02:29,260
and by that all the microorganisms are

53
00:02:36,240 --> 00:02:33,010
living here should adapt to deal with

54
00:02:38,400 --> 00:02:36,250
these low nutrient concentrations also

55
00:02:41,100 --> 00:02:38,410
we have recently discovered that these

56
00:02:43,020 --> 00:02:41,110
aquifers owners aquifers as well are a

57
00:02:44,610 --> 00:02:43,030
source of poorly understood microbes

58
00:02:47,760 --> 00:02:44,620
that can span over bill the Tree of Life

59
00:02:50,280 --> 00:02:47,770
and finally very cool discovery as well

60
00:02:52,680 --> 00:02:50,290
that we have discovered that both encho

61
00:02:55,950 --> 00:02:52,690
and methane both green houses are

62
00:02:57,090 --> 00:02:55,960
emitted from this system now when we

63
00:02:59,970 --> 00:02:57,100

talk about your chemical parameters

64
00:03:01,800 --> 00:02:59,980
within the UFA in general we will find

65
00:03:03,990 --> 00:03:01,810
that some geochemical parameters like

66
00:03:06,300 --> 00:03:04,000
what's the temperature salinity pH they

67
00:03:08,370 --> 00:03:06,310
do not change at all no matter the

68
00:03:11,490 --> 00:03:08,380
spring we go no matter the time of the

69
00:03:15,990 --> 00:03:11,500
year we go there these guys remain

70
00:03:18,030 --> 00:03:16,000
constant so these parameters are not the

71
00:03:19,530 --> 00:03:18,040
ones that are going to form us about

72
00:03:21,750 --> 00:03:19,540
processes that are happening in

73
00:03:24,960 --> 00:03:21,760
different part of the UFA whoever we

74
00:03:27,060 --> 00:03:24,970
have all parameters namely actual

75
00:03:29,850 --> 00:03:27,070
concentration in the water or oxygen

76
00:03:32,790 --> 00:03:29,860
concentration that do change either over

77
00:03:36,410 --> 00:03:32,800
time or from spring to spring now it's

78
00:03:40,130 --> 00:03:36,420
worth note that oxygen concentration

79
00:03:43,020 --> 00:03:40,140
versus entry or concentration Falls

80
00:03:45,030 --> 00:03:43,030
positive correlation except there are a

81
00:03:48,420 --> 00:03:45,040
couple of exceptions there but those are

82
00:03:51,270 --> 00:03:48,430
very particular places and this positive

83
00:03:53,640 --> 00:03:51,280
correlation with oxygen is make a star

84
00:03:57,680 --> 00:03:53,650
making us thinking about processes that

85
00:04:02,210 --> 00:03:57,690
might be producing this ain't sure

86
00:04:05,310 --> 00:04:02,220
whether there's one particular location

87
00:04:08,520 --> 00:04:05,320
called the river sink on rice and in

88
00:04:11,790 --> 00:04:08,530

this particular location we have a river

89
00:04:15,720 --> 00:04:11,800
that sinks under water underground sorry

90
00:04:19,640 --> 00:04:15,730
mixes with the UFA water and after

91
00:04:23,730 --> 00:04:19,650
around 7 kilometers it rises up again

92
00:04:24,659 --> 00:04:23,740
so in this rice after mixing with that

93
00:04:26,840 --> 00:04:24,669
UFA water

94
00:04:29,360 --> 00:04:26,850
well we have found it and

95
00:04:32,090 --> 00:04:29,370
shuo concentrations not only changed

96
00:04:37,220 --> 00:04:32,100
over time but that since also fools a

97
00:04:40,760 --> 00:04:37,230
negative correlation with oxen now we

98
00:04:45,470 --> 00:04:40,770
reach the question part how this angel

99
00:04:47,390 --> 00:04:45,480
is produced in the system well I wish

100
00:04:49,670 --> 00:04:47,400
that I could answer this question right

101
00:04:52,490 --> 00:04:49,680
now but we don't know their answer yet

102
00:04:54,710 --> 00:04:52,500
whoever we believe that the main

103
00:04:57,080 --> 00:04:54,720
processes responsible for entry or

104
00:04:59,000 --> 00:04:57,090
production in the whole nitrogen cycle

105
00:05:00,740 --> 00:04:59,010
could be responsible for Angel

106
00:05:03,590 --> 00:05:00,750
production in the system as well

107
00:05:05,240 --> 00:05:03,600
what are those processes first of all we

108
00:05:08,630 --> 00:05:05,250
have nitrification

109
00:05:12,590 --> 00:05:08,640
nitrification is the oxidation of

110
00:05:16,310 --> 00:05:12,600
ammonia all the way to nitrate and this

111
00:05:19,490 --> 00:05:16,320
process requires oxygen to happen in

112
00:05:21,950 --> 00:05:19,500
contrast we have the nitrification which

113
00:05:24,320 --> 00:05:21,960

is the reduction of nitrate or the way

114
00:05:27,350 --> 00:05:24,330
to NGO although some microorganisms

115
00:05:30,680 --> 00:05:27,360
actually stop at the level of n - n - o

116
00:05:32,930 --> 00:05:30,690
instead of the level of n chew so this

117
00:05:37,580 --> 00:05:32,940
gas is released as a consequence and the

118
00:05:40,730 --> 00:05:37,590
nitrification is anoxic it is inhibited

119
00:05:42,740 --> 00:05:40,740
in the presence of oxygen and finally

120
00:05:44,870 --> 00:05:42,750
there is a third process that is micro

121
00:05:47,060 --> 00:05:44,880
Felix or requires just a bit of oxygen

122
00:05:48,830 --> 00:05:47,070
to happen and it could be seen a circle

123
00:05:53,900 --> 00:05:48,840
as a combination of both processes

124
00:05:57,980 --> 00:05:53,910
called nitro fire denitrification so do

125
00:05:59,660 --> 00:05:57,990
we have now any hints that beyond that

126
00:06:03,800 --> 00:05:59,670
correlation with oxygen that I'll show

127
00:06:05,780 --> 00:06:03,810
you before that coming from about if any

128
00:06:09,470 --> 00:06:05,790
of this process is happening in the

129
00:06:14,930 --> 00:06:09,480
aquifer yes we do we have 16s ribosomal

130
00:06:17,600 --> 00:06:14,940
RNA gene data and with that data it's

131
00:06:19,490 --> 00:06:17,610
difficult to tell any specific pathways

132
00:06:23,420 --> 00:06:19,500
are present but at least we know that

133
00:06:26,630 --> 00:06:23,430
some micron is microorganisms that do a

134
00:06:28,760 --> 00:06:26,640
specific pathways like this file a time

135
00:06:32,540 --> 00:06:28,770
where Keota belonging to the mine

136
00:06:35,300 --> 00:06:32,550
archaea these guys are known to be emoni

137
00:06:37,460 --> 00:06:35,310
oxidizers which is the first steps of

138
00:06:38,760 --> 00:06:37,470

nitrification and as you can see they

139
00:06:41,670 --> 00:06:38,770
are presenting

140
00:06:44,070 --> 00:06:41,680
no but still significant amounts in some

141
00:06:48,230 --> 00:06:44,080
of the springs so this might be pointing

142
00:06:50,730 --> 00:06:48,240
out to me tooth decay should be a

143
00:06:52,890 --> 00:06:50,740
possible way to put this ancient or at

144
00:06:56,700 --> 00:06:52,900
least in some of these locations in fact

145
00:07:00,240 --> 00:06:56,710
I just want to stress that this LRS is

146
00:07:02,570 --> 00:07:00,250
one of the places that the most angel

147
00:07:06,559 --> 00:07:02,580
has been detected

148
00:07:10,980 --> 00:07:06,569
also because we still don't have

149
00:07:13,800 --> 00:07:10,990
metagenomic data we use program to pie

150
00:07:15,960 --> 00:07:13,810
crusts to predict some pathways that

151
00:07:18,920 --> 00:07:15,970
will be present in this aquifer is based

152
00:07:21,629 --> 00:07:18,930
on the 16s data and while we found

153
00:07:25,800 --> 00:07:21,639
interesting findings here is that the

154
00:07:28,740 --> 00:07:25,810
nitrification is relatively abundant in

155
00:07:30,330 --> 00:07:28,750
the lena river rice which was that

156
00:07:33,510 --> 00:07:30,340
specific system that i mentioned you

157
00:07:36,809 --> 00:07:33,520
before so this further strength this

158
00:07:38,399 --> 00:07:36,819
correlation with this negative

159
00:07:40,800 --> 00:07:38,409
correlation with option that we saw

160
00:07:41,999 --> 00:07:40,810
before and another thing is that this

161
00:07:43,830 --> 00:07:42,009
problem point choices that

162
00:07:45,990 --> 00:07:43,840
methanogenesis although in low numbers

163
00:07:49,409 --> 00:07:46,000

seems to be present in some of the

164
00:07:52,409 --> 00:07:49,419
aquifers well whoever one we met when we

165
00:07:54,420 --> 00:07:52,419
measure methane in all the springs we

166
00:07:57,749 --> 00:07:54,430
did not detect any methane above

167
00:08:00,719 --> 00:07:57,759
atmospheric concentrations except in one

168
00:08:02,279 --> 00:08:00,729
place there's that particular location

169
00:08:04,920 --> 00:08:02,289
that I mentioned to you before this

170
00:08:07,260 --> 00:08:04,930
river sinking rise in this specific

171
00:08:10,890 --> 00:08:07,270
location methane follows an interesting

172
00:08:12,629 --> 00:08:10,900
trend this is the methane concentration

173
00:08:14,939 --> 00:08:12,639
the water and the delta 13 values for

174
00:08:18,029 --> 00:08:14,949
the water is going in and you can see

175
00:08:21,059 --> 00:08:18,039
that these values are relatively

176
00:08:21,540 --> 00:08:21,069
constant whoever in the water is going

177
00:08:24,360 --> 00:08:21,550
out

178
00:08:27,390 --> 00:08:24,370
they both methane concentrations and

179
00:08:29,399 --> 00:08:27,400
delta 13 values changes a lot so we

180
00:08:32,219 --> 00:08:29,409
believe this could be correlated with

181
00:08:34,709 --> 00:08:32,229
both nutrient inputs oxygen the changes

182
00:08:36,719 --> 00:08:34,719
in oxygen concentration as well as yes

183
00:08:41,040 --> 00:08:36,729
amount of water is going into the system

184
00:08:43,949 --> 00:08:41,050
as well whether that doesn't mean that

185
00:08:45,930 --> 00:08:43,959
methanogenesis is not happening in any

186
00:08:48,260 --> 00:08:45,940
parts of the aquifer because according

187
00:08:52,440 --> 00:08:48,270
to verse 16 is theta we have detected

188
00:08:55,740 --> 00:08:52,450

Europe Yatta which most of the nervous

189
00:08:58,079 --> 00:08:55,750
and we also have detected methane odors

190
00:09:01,860 --> 00:08:58,089
being methanogens the guys that produce

191
00:09:04,889 --> 00:09:01,870
methane and methanol drops the guys are

192
00:09:08,579 --> 00:09:04,899
consumed methane oxidizing it well there

193
00:09:12,870 --> 00:09:08,589
is a important thing here to note that

194
00:09:15,240 --> 00:09:12,880
as you can see methanogenesis is a

195
00:09:19,560 --> 00:09:15,250
strict anaerobic process and it's

196
00:09:22,019 --> 00:09:19,570
inhibited if oxygen is present whereas

197
00:09:24,480 --> 00:09:22,029
methanol trophy is a microbe philic

198
00:09:27,750 --> 00:09:24,490
process requires a bit at least of

199
00:09:28,500 --> 00:09:27,760
oxygen to happen now if you look at the

200
00:09:29,689 --> 00:09:28,510
data here

201
00:09:32,759 --> 00:09:29,699
well there's places that only

202
00:09:34,439 --> 00:09:32,769
methanogenesis are present but there are

203
00:09:38,040 --> 00:09:34,449
all places where we can find both

204
00:09:41,040 --> 00:09:38,050
methanol drops and methanogens methanol

205
00:09:43,379 --> 00:09:41,050
ian's together now remember that we were

206
00:09:46,379 --> 00:09:43,389
well we are simply where we are sampling

207
00:09:49,379 --> 00:09:46,389
here is just a water is going out from a

208
00:09:51,930 --> 00:09:49,389
specific spring that water is going to

209
00:09:54,870 --> 00:09:51,940
collect different microbes from this

210
00:09:58,170 --> 00:09:54,880
different place of the sea of the system

211
00:10:01,160 --> 00:09:58,180
so these guys definitely cannot live

212
00:10:03,960 --> 00:10:01,170
together but the father we detect them

213
00:10:06,480 --> 00:10:03,970

in our samples means two things that

214
00:10:08,430 --> 00:10:06,490
methanogenesis could happen that that

215
00:10:10,230 --> 00:10:08,440
methane is probably consumed because we

216
00:10:12,920 --> 00:10:10,240
don't detect that in our water samples

217
00:10:15,329 --> 00:10:12,930
before it relates to the surface and

218
00:10:20,550 --> 00:10:15,339
also that this system that we are

219
00:10:21,090 --> 00:10:20,560
working is algae rings so an important

220
00:10:24,360 --> 00:10:21,100
thing

221
00:10:27,509 --> 00:10:24,370
another cool finding is that we have

222
00:10:30,660 --> 00:10:27,519
detected these microorganisms that

223
00:10:33,269 --> 00:10:30,670
belongs to these poorly known groups

224
00:10:36,449 --> 00:10:33,279
only one is a bacterial group also known

225
00:10:40,470 --> 00:10:36,459
as bacteria the peninsular peer group

226
00:10:42,329 --> 00:10:40,480
that encompass different archaea phyla

227
00:10:44,400 --> 00:10:42,339
although they belong to these two

228
00:10:47,309 --> 00:10:44,410
different domains of life they share a

229
00:10:48,930 --> 00:10:47,319
lot of similarities they are they have

230
00:10:50,699 --> 00:10:48,940
reduced genomes they are believed to be

231
00:10:53,040 --> 00:10:50,709
some by oats they are anaerobes they are

232
00:10:55,680 --> 00:10:53,050
believed to be fermenters and they are

233
00:10:57,120 --> 00:10:55,690
very small and you may ask yourself what

234
00:10:59,340 --> 00:10:57,130
you're talking about bacteria of course

235
00:11:02,220 --> 00:10:59,350
they are going to be small well these

236
00:11:04,860 --> 00:11:02,230
guys are small even for any

237
00:11:06,030 --> 00:11:04,870
microorganism they are small enough the

238
00:11:08,189 --> 00:11:06,040

go through zero point

239
00:11:11,040 --> 00:11:08,199
to micrometer filters which are in

240
00:11:14,990 --> 00:11:11,050
microbiology they are assumed to retain

241
00:11:18,120 --> 00:11:15,000
pretty much all microorganisms well

242
00:11:22,530 --> 00:11:18,130
that's why that's the reason we use 0.1

243
00:11:25,949 --> 00:11:22,540
filters to sample the water and we have

244
00:11:30,199 --> 00:11:25,959
detected that in this of 0.1 micrometer

245
00:11:33,900 --> 00:11:30,209
filters the the populations of

246
00:11:38,490 --> 00:11:33,910
microorganisms are composed by up to 70%

247
00:11:41,220 --> 00:11:38,500
of these guys so that that is surface

248
00:11:43,530 --> 00:11:41,230
appearances in finding and the main

249
00:11:45,840 --> 00:11:43,540
question is and the reason I brought up

250
00:11:48,930 --> 00:11:45,850
this microorganism is here in

251
00:11:50,939 --> 00:11:48,940
relationship with this greenhouse gases

252
00:11:54,059 --> 00:11:50,949
that we have detected is the fact that

253
00:11:58,439 --> 00:11:54,069
we don't really know what these guys are

254
00:12:01,050 --> 00:11:58,449
doing and they might be even carrying

255
00:12:05,069 --> 00:12:01,060
out pathways that we don't know yet that

256
00:12:07,650 --> 00:12:05,079
nobody has described it and that might

257
00:12:12,990 --> 00:12:07,660
contribute to this either methane or

258
00:12:15,389 --> 00:12:13,000
entry or production so now yes to

259
00:12:18,420 --> 00:12:15,399
conclude and remark the three main

260
00:12:21,210 --> 00:12:18,430
points of this talk first of all we have

261
00:12:24,210 --> 00:12:21,220
detected methane at least in some

262
00:12:26,910 --> 00:12:24,220
specific locations of decision and encho

263
00:12:29,340 --> 00:12:26,920

above atmospheric concentrations in all

264
00:12:32,730 --> 00:12:29,350
the springs that we have simple how

265
00:12:35,400 --> 00:12:32,740
these gases are produced we don't really

266
00:12:40,230 --> 00:12:35,410
still have the key yet especially for

267
00:12:41,850 --> 00:12:40,240
intro but we believe that you know the

268
00:12:44,069 --> 00:12:41,860
production is a strongly related with

269
00:12:46,889 --> 00:12:44,079
microbial activity and we would like to

270
00:12:48,990 --> 00:12:46,899
in future studies see if there are any

271
00:12:53,460 --> 00:12:49,000
particularity of entry on methane

272
00:12:55,769 --> 00:12:53,470
related with microbes that made the use

273
00:12:58,949 --> 00:12:55,779
of these two gases as potential

274
00:13:01,019 --> 00:12:58,959
biomarkers then of course the aquifers I

275
00:13:02,730 --> 00:13:01,029
mean as I mentioned to you before seems

276
00:13:04,769 --> 00:13:02,740
to be a heterogeneous environment and

277
00:13:07,769 --> 00:13:04,779
that will be a very cool system to

278
00:13:10,650 --> 00:13:07,779
compare how some microorganisms are able

279
00:13:13,590 --> 00:13:10,660
to thrive in a low energy environment

280
00:13:15,569 --> 00:13:13,600
and determine exactly what's the

281
00:13:19,810 --> 00:13:15,579
contribution of any nutrients from the

282
00:13:23,230 --> 00:13:19,820
surface for the habitability of

283
00:13:25,210 --> 00:13:23,240
specific extreme environment and finally

284
00:13:28,750 --> 00:13:25,220
the father we had detected this bully

285
00:13:31,000 --> 00:13:28,760
study microorganisms not only opens the

286
00:13:33,940 --> 00:13:31,010
door to new pathways dare to be

287
00:13:37,230 --> 00:13:33,950
described but also it allows us to

288
00:13:41,620 --> 00:13:37,240

expand our view of the Tree of Life and

289
00:13:44,080 --> 00:13:41,630
what are the actual limits of life not

290
00:13:46,320 --> 00:13:44,090
only in terms of physiological limits

291
00:13:49,750 --> 00:13:46,330
but even in term of size limits as well

292
00:13:52,150 --> 00:13:49,760
so with all of that I would like to

293
00:13:54,070 --> 00:13:52,160
conclude thanking of course on my

294
00:13:56,410 --> 00:13:54,080
committee members all the members of my

295
00:13:59,290 --> 00:13:56,420
lab as well as all the collaborators

296
00:14:01,720 --> 00:13:59,300
have have made this project possible and

297
00:14:03,670 --> 00:14:01,730
of course the University of Florida by

298
00:14:05,320 --> 00:14:03,680
University Institute for providing the

299
00:14:07,030 --> 00:14:05,330
funding for making this very possible

300
00:14:08,830 --> 00:14:07,040
with all of that thank you very much for

301
00:14:23,200 --> 00:14:08,840
your attention and I will be open for

302
00:14:26,260 --> 00:14:23,210
any questions so as you alluded to

303
00:14:29,830 --> 00:14:26,270
earlier you haven't you don't know what

304
00:14:31,690 --> 00:14:29,840
these organisms are doing have you do

305
00:14:34,240 --> 00:14:31,700
you guys have plans to look at the meta

306
00:14:37,510 --> 00:14:34,250
transcriptome of the samples that you

307
00:14:39,820 --> 00:14:37,520
look at so far yeah well one of the next

308
00:14:42,340 --> 00:14:39,830
step of this project is definitely look

309
00:14:44,140 --> 00:14:42,350
at metagenomics in general and see not

310
00:14:46,870 --> 00:14:44,150
only what these guys are doing in the

311
00:14:48,910 --> 00:14:46,880
aquifer but also what other organisms

312
00:14:51,130 --> 00:14:48,920
are doing as well as specifically for

313
00:14:52,000 --> 00:14:51,140

these organisms the members of the

314
00:14:55,120 --> 00:14:52,010
Defiant phyla

315
00:14:57,220 --> 00:14:55,130
they are believed to be anaerobes and

316
00:14:59,140 --> 00:14:57,230
some of them fermenters just based on

317
00:15:02,050 --> 00:14:59,150
methods in an exercise that other

318
00:15:05,320 --> 00:15:02,060
authors have done and they some of them

319
00:15:07,330 --> 00:15:05,330
they lack of many of the machineries for

320
00:15:11,470 --> 00:15:07,340
production of amino acids and lipids and

321
00:15:13,480 --> 00:15:11,480
even synthesis of nucleic acids so some

322
00:15:15,610 --> 00:15:13,490
of the authors believe that they might

323
00:15:17,380 --> 00:15:15,620
be some buyouts of other organisms and

324
00:15:20,200 --> 00:15:17,390
if they are sent by H we would like to

325
00:15:33,030 --> 00:15:20,210
know exactly which organisms they are

326
00:15:43,240 --> 00:15:36,220
okay if there are no and if they're not

327
00:15:45,940 --> 00:15:43,250
any other questions Thanks

328
00:15:47,560 --> 00:15:45,950
could you speak a little bit more to the

329
00:15:49,420 --> 00:15:47,570
water column chemistry as you know it

330
00:15:54,640 --> 00:15:49,430
and if there's any significant sort of

331
00:15:58,300 --> 00:15:54,650
chemo client's going on there so it's

332
00:16:01,530 --> 00:15:58,310
important to note that we're not working

333
00:16:05,350 --> 00:16:01,540
in a lake we are working in an aquifer

334
00:16:07,540 --> 00:16:05,360
so any nation of water come will be a

335
00:16:11,350 --> 00:16:07,550
bit biased because you know it's not

336
00:16:13,900 --> 00:16:11,360
that we stick a probe underground you

337
00:16:15,250 --> 00:16:13,910
know then we have like an ocean layer

338
00:16:19,980 --> 00:16:15,260

and then on an ox layer or something

339
00:16:23,140 --> 00:16:19,990
like that it's more like it's more of

340
00:16:27,850 --> 00:16:23,150
geographical spread of the indecision

341
00:16:30,640 --> 00:16:27,860
that we have some Springs that all these

342
00:16:32,290 --> 00:16:30,650
Springs are oxic and that's there's the

343
00:16:34,360 --> 00:16:32,300
only water we can sample is something

344
00:16:37,900 --> 00:16:34,370
the water is discharged from these

345
00:16:39,670 --> 00:16:37,910
Springs weather although in all the

346
00:16:42,040 --> 00:16:39,680
springs are exceed their some of them

347
00:16:44,980 --> 00:16:42,050
that have very load you we're I'm

348
00:16:47,680 --> 00:16:44,990
talking about concentration around 1.5

349
00:16:50,020 --> 00:16:47,690
to 2 percent D so function and there are

350
00:16:52,360 --> 00:16:50,030
other Springs that have relatively high

351
00:16:56,560 --> 00:16:52,370
values the highest and members around

352
00:16:58,300 --> 00:16:56,570
55% is so function so we cannot talk

353
00:17:00,010 --> 00:16:58,310
about an actual water column but

354
00:17:01,840 --> 00:17:00,020
definitely we can see geographical

355
00:17:11,170 --> 00:17:01,850
difference between the difference

356
00:17:14,020 --> 00:17:11,180
principle Center thanks are you choosing

357
00:17:15,130 --> 00:17:14,030
Springs that have a lot of human some of

358
00:17:16,270 --> 00:17:15,140
these Springs are pretty busy I don't

359
00:17:17,620 --> 00:17:16,280
know exactly know which ones you're

360
00:17:19,660 --> 00:17:17,630
using but I know some of the Florida

361
00:17:21,880 --> 00:17:19,670
Springs get really busy with people and

362
00:17:24,400 --> 00:17:21,890
are you trying to control at all for any

363
00:17:26,530 --> 00:17:24,410

human influence well we don't really

364
00:17:29,440 --> 00:17:26,540
care that much about human influence

365
00:17:31,600 --> 00:17:29,450
because many of these Springs they have

366
00:17:34,150 --> 00:17:31,610
like a very strong current in fact

367
00:17:36,160 --> 00:17:34,160
something there is a challenge because

368
00:17:38,680 --> 00:17:36,170
it's very difficult just to swim above

369
00:17:39,950 --> 00:17:38,690
the bend where we have to deploy our

370
00:17:42,769 --> 00:17:39,960
instruments

371
00:17:45,440 --> 00:17:42,779
so if there's any humans with their

372
00:17:49,060 --> 00:17:45,450
bacterias around now everything will be

373
00:17:52,149 --> 00:17:49,070
washed off by the water current itself

374
00:17:54,649 --> 00:17:52,159
another thing of working this very

375
00:17:57,019 --> 00:17:54,659
populated spring specially the summer in

376
00:17:59,539 --> 00:17:57,029
Florida you know they are even better

377
00:18:03,680 --> 00:17:59,549
than going to a beach for most part is

378
00:18:05,899 --> 00:18:03,690
that you know it's that interaction with

379
00:18:08,419 --> 00:18:05,909
people that makes easier kind of like

380
00:18:10,250 --> 00:18:08,429
diffuser where our work many people use

381
00:18:12,260 --> 00:18:10,260
concur is like hey what you're doing and

382
00:18:14,000 --> 00:18:12,270
we have to pretty much explain in the

383
00:18:16,130 --> 00:18:14,010
field what what they are we are we are

384
00:18:21,700 --> 00:18:16,140
doing with our wind instruments and all

385
00:18:29,990 --> 00:18:28,639
ok one more quick question so it's got

386
00:18:32,539 --> 00:18:30,000
to be very quick but so that's a very

387
00:18:34,100 --> 00:18:32,549
populated area as some people alluded to

388
00:18:35,330 --> 00:18:34,110

so I'm actually wondering if you did any

389
00:18:37,789 --> 00:18:35,340
sort of mapping to see where the

390
00:18:39,940 --> 00:18:37,799
research for the aquifer is and if that

391
00:18:42,019 --> 00:18:39,950
can influence the amount of nitrates or

392
00:18:43,549 --> 00:18:42,029
ammonia or nitrogen that's in the system

393
00:18:46,220 --> 00:18:43,559
already by the time it goes through the

394
00:18:48,200 --> 00:18:46,230
spring yes for the research of the

395
00:18:50,450 --> 00:18:48,210
aquifer there are two main areas when

396
00:18:52,700 --> 00:18:50,460
it's like a lateral which starts coming

397
00:18:54,889 --> 00:18:52,710
from the north and then there is all

398
00:18:56,570 --> 00:18:54,899
this sunken finally that of course is a

399
00:18:59,210 --> 00:18:56,580
recharge area and there are some

400
00:19:00,769 --> 00:18:59,220
problems here with you know nitrogen

401
00:19:03,470 --> 00:19:00,779
fertilizer runoff

402
00:19:06,230 --> 00:19:03,480
so actually in natural concentration the

403
00:19:07,870 --> 00:19:06,240
waters relatively low but we believe

404
00:19:12,399 --> 00:19:07,880
that some part of the problem is that

405
00:19:14,630 --> 00:19:12,409
that nitrate or some other

406
00:19:17,060 --> 00:19:14,640
transformation other species of nitrogen