
AbSciCon
2019

1
00:00:00,790 --> 00:00:07,320
[Music]

2
00:00:12,600 --> 00:00:09,140
[Applause]

3
00:00:13,680 --> 00:00:12,610
hi everyone my name is Amy Smith and I'm

4
00:00:16,199 --> 00:00:13,690
from Woods Hole Oceanographic

5
00:00:18,330 --> 00:00:16,209
Institution and today I'm gonna talk to

6
00:00:21,720 --> 00:00:18,340
you about Loihi seamount and its

7
00:00:24,390 --> 00:00:21,730
potential for an scientific analog to

8
00:00:28,620 --> 00:00:24,400
Enceladus or other ocean worlds that

9
00:00:33,630 --> 00:00:28,630
might have I've been sent just it might

10
00:00:35,490 --> 00:00:33,640
have some applications to two

11
00:00:38,700 --> 00:00:35,500
hydrothermal vents on other ocean worlds

12
00:00:40,830 --> 00:00:38,710
so I have a lot of co-authors here

13
00:00:44,550 --> 00:00:40,840

because this is a big collaboration

14
00:00:47,280 --> 00:00:44,560
between NASA NOAA ohe Woods Hole and

15
00:00:49,200 --> 00:00:47,290
some other universities and then there

16
00:00:51,420 --> 00:00:49,210
were some other older samples that I

17
00:00:53,760 --> 00:00:51,430
used that I'm going to talk about today

18
00:00:58,290 --> 00:00:53,770
as well from the way he see Mount that

19
00:01:00,450 --> 00:00:58,300
were part of the female project so let

20
00:01:01,920 --> 00:01:00,460
me get started so I'm what you're

21
00:01:04,350 --> 00:01:01,930
looking at right now is actually a

22
00:01:06,840 --> 00:01:04,360
hydrothermal vent I know it might not

23
00:01:09,600 --> 00:01:06,850
look to you like what you've seen or

24
00:01:12,870 --> 00:01:09,610
imagined a hydrothermal vent to be it's

25
00:01:14,490 --> 00:01:12,880
rather small but the temperatures of the

26
00:01:18,180 --> 00:01:14,500
fluids coming out of this vent are about

27
00:01:20,580 --> 00:01:18,190
40 30 to 40 degrees Celsius and you can

28
00:01:24,120 --> 00:01:20,590
see that there are a lot of orange

29
00:01:26,670 --> 00:01:24,130
yellow fluff around that's actually a

30
00:01:29,250 --> 00:01:26,680
bacterial mat mostly it's made up of

31
00:01:32,330 --> 00:01:29,260
this organism called Mara profundis for

32
00:01:35,520 --> 00:01:32,340
Aqsa dams which is deep subsurface

33
00:01:37,740 --> 00:01:35,530
organism that oxidizes iron and fixes

34
00:01:39,810 --> 00:01:37,750
carbon and so these organisms

35
00:01:42,149 --> 00:01:39,820
characterize this environment you can

36
00:01:44,039 --> 00:01:42,159
see them all over the rocks at the tip

37
00:01:47,999 --> 00:01:44,049
at the top of this volcano we have these

38
00:01:50,700 --> 00:01:48,009

hydrothermal vents and this actually we

39
00:01:52,530 --> 00:01:50,710
named dragons Dragon's cave because it

40
00:01:56,100 --> 00:01:52,540
kind of does look like it has dragons

41
00:01:57,539 --> 00:01:56,110
eggs inside the cave so that's one of

42
00:02:00,870 --> 00:01:57,549
the places that I'll talk to you about

43
00:02:03,510 --> 00:02:00,880
today so there are lots of ocean worlds

44
00:02:05,819 --> 00:02:03,520
in our solar system and besides earth my

45
00:02:07,889 --> 00:02:05,829
favorite one is Enceladus because we

46
00:02:09,749 --> 00:02:07,899
have evidence of hydrogen production and

47
00:02:14,039 --> 00:02:09,759
there might be hydrothermal vents on

48
00:02:16,800 --> 00:02:14,049
Enceladus so the reason why we went to

49
00:02:18,720 --> 00:02:16,810
Loihi seamount is because it we think it

50
00:02:20,559 --> 00:02:18,730
might be a good analog for this type of

51
00:02:23,410 --> 00:02:20,569
environment main

52
00:02:25,750 --> 00:02:23,420
because this hydrothermal vent system is

53
00:02:27,520 --> 00:02:25,760
not on a spreading Ridge which is where

54
00:02:30,369 --> 00:02:27,530
you find most of them it's actually an

55
00:02:32,500 --> 00:02:30,379
inter inter plate hotspot volcano and

56
00:02:34,239 --> 00:02:32,510
because we don't expect for plate

57
00:02:37,030 --> 00:02:34,249
tectonics to exist on these other worlds

58
00:02:39,399 --> 00:02:37,040
this is probably more likely like what

59
00:02:40,869 --> 00:02:39,409
we would find

60
00:02:43,030 --> 00:02:40,879
so at Luigi seamount we have

61
00:02:45,849 --> 00:02:43,040
hydrothermal venting it's a hot squat

62
00:02:47,110 --> 00:02:45,859
volcano there's no sunlight because it's

63
00:02:49,360 --> 00:02:47,120

about a thousand meters below the

64
00:02:51,190 --> 00:02:49,370
surface and there are water rock

65
00:02:53,229 --> 00:02:51,200
reactions to drive chemosynthesis and

66
00:02:56,379 --> 00:02:53,239
these organisms at the surface that you

67
00:02:58,349 --> 00:02:56,389
see in the mat here this is one of those

68
00:03:00,550 --> 00:02:58,359
mats of mayer profundus rock sedan's

69
00:03:04,119 --> 00:03:00,560
those are actually chemosynthetic

70
00:03:05,830 --> 00:03:04,129
organisms as well and then this whoops

71
00:03:09,039 --> 00:03:05,840
sorry

72
00:03:11,319 --> 00:03:09,049
this blue dots here those are actually

73
00:03:13,780 --> 00:03:11,329
microbes in fluids from Loihi seamount

74
00:03:15,610 --> 00:03:13,790
if you can stain the DNA of the microbes

75
00:03:18,939 --> 00:03:15,620
and look at it under the microscope and

76
00:03:22,899 --> 00:03:18,949
that's what they they look like so this

77
00:03:25,210 --> 00:03:22,909
is a map of Hawaii here and then you can

78
00:03:27,280 --> 00:03:25,220
see this is the hot spot that created

79
00:03:28,839 --> 00:03:27,290
all the Hawaiian Islands and Loihi is

80
00:03:30,999 --> 00:03:28,849
the next Island that's being formed

81
00:03:35,369 --> 00:03:31,009
underneath the ocean right next to the

82
00:03:38,020 --> 00:03:35,379
Big Island so what makes Loihi seamount

83
00:03:39,999 --> 00:03:38,030
interesting is that it's very different

84
00:03:42,670 --> 00:03:40,009
from on accident sites as I mentioned

85
00:03:44,740 --> 00:03:42,680
it's also a low temperature site so that

86
00:03:47,409 --> 00:03:44,750
the temperatures of the fluids are

87
00:03:48,490 --> 00:03:47,419
around 30 to 40 degrees Celsius at some

88
00:03:51,009 --> 00:03:48,500

point they were a little bit higher

89
00:03:52,689 --> 00:03:51,019
sometimes they're lower but what's

90
00:03:55,719 --> 00:03:52,699
interesting also is that there's no

91
00:03:58,689 --> 00:03:55,729
sulfide in the fluids there's a lot of

92
00:04:01,179 --> 00:03:58,699
iron and co2 and there's a little bit of

93
00:04:03,369 --> 00:04:01,189
hydrogen it's below the detection limit

94
00:04:05,649 --> 00:04:03,379
which is about three micro molar or less

95
00:04:08,199 --> 00:04:05,659
but still it's possible that microbes

96
00:04:11,110 --> 00:04:08,209
could use it for energy we don't see

97
00:04:13,300 --> 00:04:11,120
very many like typical vent organisms at

98
00:04:17,589 --> 00:04:13,310
this site we only really see those mats

99
00:04:20,740 --> 00:04:17,599
couple of shrimp and a few butte fish a

100
00:04:24,700 --> 00:04:20,750
previous paper by jason silva at all in

101
00:04:27,279 --> 00:04:24,710
2017 said that nitrogen sulfur and iron

102
00:04:28,689 --> 00:04:27,289
metabolisms are probably likely in the

103
00:04:31,420 --> 00:04:28,699
fluids that are coming out of the vents

104
00:04:32,610 --> 00:04:31,430
but at that time really it's just energy

105
00:04:34,920 --> 00:04:32,620
modeling

106
00:04:36,990 --> 00:04:34,930
and he had some taxonomy that he

107
00:04:39,000 --> 00:04:37,000
reported and then I have taken those

108
00:04:40,920 --> 00:04:39,010
fluids and looked more deeply at the

109
00:04:44,219 --> 00:04:40,930
meta genomes and I'll present that as

110
00:04:46,350 --> 00:04:44,229
well today so as I mentioned before

111
00:04:49,560 --> 00:04:46,360
there this location is dominated by

112
00:04:50,939 --> 00:04:49,570
these iron mats or my profundus but one

113
00:04:53,280 --> 00:04:50,949

interesting thing I want to point out is

114
00:04:55,080 --> 00:04:53,290
that they have to have oxygen and

115
00:04:57,300 --> 00:04:55,090
whether or not there's oxygen on some of

116
00:04:57,750 --> 00:04:57,310
these other ocean worlds is up for

117
00:05:00,719 --> 00:04:57,760
debate

118
00:05:03,629 --> 00:05:00,729
so we're not really sure if this is a

119
00:05:05,820 --> 00:05:03,639
good location or not based on that but

120
00:05:07,379 --> 00:05:05,830
there are other ways to oxidize iron so

121
00:05:09,779 --> 00:05:07,389
it's possible that that this type of

122
00:05:11,460 --> 00:05:09,789
organism could exist so our main

123
00:05:13,830 --> 00:05:11,470
question what this study was to look

124
00:05:16,080 --> 00:05:13,840
like what to look at what life looks

125
00:05:18,120 --> 00:05:16,090
like in the subsurface not necessarily

126
00:05:21,840 --> 00:05:18,130
focusing on those iron mats that have

127
00:05:26,159 --> 00:05:21,850
been studied for years and years so what

128
00:05:28,650 --> 00:05:26,169
I did in on a recent cruise in August

129
00:05:30,180 --> 00:05:28,660
and September of last year was to take

130
00:05:33,300 --> 00:05:30,190
some fluid samples from several

131
00:05:35,610 --> 00:05:33,310
different sites on the Luisi mount and

132
00:05:37,529 --> 00:05:35,620
look at cell densities just get an idea

133
00:05:38,909 --> 00:05:37,539
of how much energy might be in the

134
00:05:41,430 --> 00:05:38,919
system and how much biomass can be

135
00:05:45,029 --> 00:05:41,440
supported by that look at the taxonomy

136
00:05:48,960 --> 00:05:45,039
again do meta-genome studies and then to

137
00:05:51,510 --> 00:05:48,970
culture some organisms oh and you can

138
00:05:53,879 --> 00:05:51,520

notice here this is also another event

139
00:05:56,100 --> 00:05:53,889
site that we were sampling this is

140
00:05:57,990 --> 00:05:56,110
called a super sampler that we used to

141
00:06:01,740 --> 00:05:58,000
sample the fluids that are coming out of

142
00:06:06,300 --> 00:06:01,750
the rock also I'll be talking briefly

143
00:06:09,719 --> 00:06:06,310
about a last bit of our cruise we were

144
00:06:11,430 --> 00:06:09,729
able to go and sample some of some vent

145
00:06:14,580 --> 00:06:11,440
well if not vent fluid necessarily but

146
00:06:17,310 --> 00:06:14,590
some fluids from the Kilauea ocean entry

147
00:06:17,930 --> 00:06:17,320
site if you remember in August of last

148
00:06:21,719 --> 00:06:17,940
year

149
00:06:24,060 --> 00:06:21,729
Kilauea had just been erupting for a

150
00:06:27,240 --> 00:06:24,070
period of time for several weeks a

151
00:06:28,830 --> 00:06:27,250
couple of months and then so we went to

152
00:06:31,620 --> 00:06:28,840
that site at the very end of our cruise

153
00:06:33,270 --> 00:06:31,630
to look at the ocean entry to see if we

154
00:06:35,700 --> 00:06:33,280
could see any life there that had

155
00:06:39,240 --> 00:06:35,710
colonized the basalt that had gotten

156
00:06:40,589 --> 00:06:39,250
into the ocean I will also like to point

157
00:06:42,630 --> 00:06:40,599
out that during our cruise that was

158
00:06:44,149 --> 00:06:42,640
three weeks there were four hurricanes

159
00:06:46,279 --> 00:06:44,159
so

160
00:06:49,040 --> 00:06:46,289
the first hurricane was hurricane lane

161
00:06:51,439 --> 00:06:49,050
and it kind of hit that big island

162
00:06:54,350 --> 00:06:51,449
pretty hard so I'm gonna show you a

163
00:06:56,359 --> 00:06:54,360

video of what we encountered on the

164
00:06:57,799 --> 00:06:56,369
ocean entry site and it doesn't look

165
00:06:59,059 --> 00:06:57,809
like fresh basalt because it's covered

166
00:07:02,029 --> 00:06:59,069
in sediment and they're like palm trees

167
00:07:02,419 --> 00:07:02,039
and stuff everywhere but um that's what

168
00:07:07,279 --> 00:07:02,429
it is

169
00:07:10,939 --> 00:07:07,289
trust me okay so um this is 635 meters

170
00:07:14,179 --> 00:07:10,949
down at the Kilauea ocean entry site and

171
00:07:15,439 --> 00:07:14,189
you might recognize something um kind of

172
00:07:18,559 --> 00:07:15,449
blowing in the wind that orange a yellow

173
00:07:21,219 --> 00:07:18,569
looking microbial mat there so we got a

174
00:07:23,239 --> 00:07:21,229
sample of the mat and then we're

175
00:07:25,040 --> 00:07:23,249
sticking our super sampler and the

176
00:07:27,739 --> 00:07:25,050
different holes to see if we could find

177
00:07:30,999 --> 00:07:27,749
any fluid flow and we actually measured

178
00:07:34,239 --> 00:07:31,009
a elevation of temperature 0.8 degrees

179
00:07:37,699 --> 00:07:34,249
above ambient so just a little bit

180
00:07:40,939 --> 00:07:37,709
warmer but it was still warm after three

181
00:07:43,519 --> 00:07:40,949
weeks of inactivity from the volcano so

182
00:07:44,899 --> 00:07:43,529
that was pretty exciting to us and it

183
00:07:47,269 --> 00:07:44,909
was also really exciting that we saw

184
00:07:49,399 --> 00:07:47,279
life had already colonized there and it

185
00:07:52,449 --> 00:07:49,409
looks a lot like what we saw at Loihi

186
00:07:55,909 --> 00:07:52,459
seamount which is not part not far away

187
00:07:58,249 --> 00:07:55,919
so um I also have a couple of videos of

188
00:08:01,730 --> 00:07:58,259

some really cool microbes that I was

189
00:08:03,769 --> 00:08:01,740
able to produce and culture on the ship

190
00:08:05,929 --> 00:08:03,779
while we were there the first one is

191
00:08:09,049 --> 00:08:05,939
that iron oxidizer or sorry iron reducer

192
00:08:12,829 --> 00:08:09,059
enrichment which grew pretty well and

193
00:08:16,369 --> 00:08:12,839
then the the other is a rock that we

194
00:08:18,439 --> 00:08:16,379
took from a an old vent that was at the

195
00:08:20,509 --> 00:08:18,449
top of Luisi mount but you can see there

196
00:08:22,219 --> 00:08:20,519
are a lot of sulfides and it's quite

197
00:08:23,659 --> 00:08:22,229
beautiful and I just couldn't stop

198
00:08:26,839 --> 00:08:23,669
staring at it and I didn't want to give

199
00:08:28,819 --> 00:08:26,849
that rock away but I had to and then

200
00:08:31,189 --> 00:08:28,829
these are some of the other beautiful

201
00:08:36,490 --> 00:08:31,199
rocks that we were able to collect from

202
00:08:42,920 --> 00:08:36,500
the cipa summit hopefully it will

203
00:08:44,990 --> 00:08:42,930
advance okay so okay so now I want to

204
00:08:46,759 --> 00:08:45,000
talk to you about the cell density in

205
00:08:49,429 --> 00:08:46,769
these fluids and how it compares to some

206
00:08:50,660 --> 00:08:49,439
other sites as far as whether or not

207
00:08:54,290 --> 00:08:50,670
they're hydrothermal vents or bottom

208
00:08:56,810 --> 00:08:54,300
seawater so if you can see all of the

209
00:09:00,300 --> 00:08:56,820
orange bars here are

210
00:09:03,900 --> 00:09:00,310
cell counts from Loihi seamount the

211
00:09:05,220 --> 00:09:03,910
first set is from nineteen the 1980s

212
00:09:08,100 --> 00:09:05,230
that were reported right after an

213
00:09:11,880 --> 00:09:08,110

eruption and then these here are the

214
00:09:14,579 --> 00:09:11,890
ones from the 2018 sampling site that we

215
00:09:16,620 --> 00:09:14,589
took and then this is that mustard

216
00:09:19,560 --> 00:09:16,630
Hallows what we're calling it the kill

217
00:09:20,519 --> 00:09:19,570
away and ocean entry site so those

218
00:09:25,350 --> 00:09:20,529
fluids that were point eight degrees

219
00:09:27,570 --> 00:09:25,360
above ambient so those are all the cell

220
00:09:30,300 --> 00:09:27,580
densities here and then if you follow

221
00:09:33,900 --> 00:09:30,310
this line that will show you where Loihi

222
00:09:35,840 --> 00:09:33,910
comes out on this graph all of the light

223
00:09:38,970 --> 00:09:35,850
blue are bottom sea water samples

224
00:09:41,610 --> 00:09:38,980
whether or not they're close to Loihi or

225
00:09:44,460 --> 00:09:41,620
in another location they all kind of are

226
00:09:47,550 --> 00:09:44,470
a little bit lower than Loihi but Loihi

227
00:09:50,030 --> 00:09:47,560
in general is kind of in between what we

228
00:09:53,730 --> 00:09:50,040
might find in bottom sea water and a

229
00:09:55,920 --> 00:09:53,740
sulfide rich hydrothermal vents such as

230
00:09:58,260 --> 00:09:55,930
this one which is Mariana back-arc here

231
00:10:01,199 --> 00:09:58,270
so you can see those are much higher

232
00:10:03,329 --> 00:10:01,209
cell densities and those also have

233
00:10:05,970 --> 00:10:03,339
support a large amount of macro fauna

234
00:10:08,340 --> 00:10:05,980
and lots of other life forms as well so

235
00:10:13,620 --> 00:10:08,350
Luigi as looks looks like it's kind of a

236
00:10:16,350 --> 00:10:13,630
lower energy hydrothermal vent system so

237
00:10:20,550 --> 00:10:16,360
this is the 2018 data that we got the

238
00:10:23,220 --> 00:10:20,560

first top bar is the bottom seawater

239
00:10:25,170 --> 00:10:23,230
then we have that mustard holo which is

240
00:10:26,790 --> 00:10:25,180
the ocean entry site and then these are

241
00:10:29,370 --> 00:10:26,800
some of the different events that we

242
00:10:32,010 --> 00:10:29,380
sampled at Loihi and this is just

243
00:10:34,829 --> 00:10:32,020
looking at the taxonomy from meta-genome

244
00:10:37,050 --> 00:10:34,839
that or metagenomes that I have been

245
00:10:38,970 --> 00:10:37,060
producing in the lab that are now ready

246
00:10:41,699 --> 00:10:38,980
to be sequenced but we wanted to check

247
00:10:43,260 --> 00:10:41,709
the taxonomy first and you can see

248
00:10:44,940 --> 00:10:43,270
actually anything that's yellow or

249
00:10:46,980 --> 00:10:44,950
orange I've tried to color code with

250
00:10:49,199 --> 00:10:46,990
that's a mayor profundus so that same

251
00:10:51,360 --> 00:10:49,209
organism that you find in the mat at the

252
00:10:53,699 --> 00:10:51,370
surface okay so we've got three

253
00:10:55,319 --> 00:10:53,709
different types of mayor profundus which

254
00:10:58,680 --> 00:10:55,329
sorry which are the most abundant

255
00:11:01,590 --> 00:10:58,690
organisms here and then even in that

256
00:11:02,970 --> 00:11:01,600
mustard holo sight so that math looked

257
00:11:05,940 --> 00:11:02,980
like it might have been one of those

258
00:11:07,960 --> 00:11:05,950
types of organisms actually was so on

259
00:11:11,079 --> 00:11:07,970
the same organisms that colonize

260
00:11:13,089 --> 00:11:11,089
the vent sites at Lewicki are actually

261
00:11:16,359 --> 00:11:13,099
colonizing new lava flows that are

262
00:11:19,059 --> 00:11:16,369
coming into the ocean at the Kilauea

263
00:11:22,439 --> 00:11:19,069

Volcano site as well and then we have

264
00:11:25,599 --> 00:11:22,449
some other organisms that are unknown or

265
00:11:27,969 --> 00:11:25,609
grossly unknown I guess so

266
00:11:29,739 --> 00:11:27,979
hopefully the meta-genome metagenomes

267
00:11:31,119 --> 00:11:29,749
that i produce later will give us more

268
00:11:33,219 --> 00:11:31,129
information about what these organisms

269
00:11:35,559 --> 00:11:33,229
are doing there and whether or not

270
00:11:39,609 --> 00:11:35,569
they're actually doing what they what we

271
00:11:42,339 --> 00:11:39,619
think they are and so now I'm looking at

272
00:11:44,679 --> 00:11:42,349
2006 data so this is emitted these are

273
00:11:47,710 --> 00:11:44,689
metagenomes from some samples that were

274
00:11:50,199 --> 00:11:47,720
taken in 2006 it's at the same locations

275
00:11:51,219 --> 00:11:50,209
so we have again bottom sea water and

276
00:11:55,089 --> 00:11:51,229
then these are three of the different

277
00:11:57,099 --> 00:11:55,099
vent sites and you can see based on this

278
00:11:58,779 --> 00:11:57,109
is just carbon fixation and the amount

279
00:12:01,269 --> 00:11:58,789
of genes that were present and each of

280
00:12:04,119 --> 00:12:01,279
the metagenomes and then which pathways

281
00:12:07,239 --> 00:12:04,129
are that these are present in is color

282
00:12:09,069 --> 00:12:07,249
coded and you can note for sure right

283
00:12:11,439 --> 00:12:09,079
away that you have some yellow and

284
00:12:14,529 --> 00:12:11,449
Pink's here that are present in the

285
00:12:16,029 --> 00:12:14,539
Loihi luigi's seamount samples that are

286
00:12:17,829 --> 00:12:16,039
not present in the bottom seawater and

287
00:12:20,499 --> 00:12:17,839
those are anaerobic carbon fixation

288
00:12:24,309 --> 00:12:20,509

pathways so the ones and the bottom sea

289
00:12:28,239 --> 00:12:24,319
water are mostly Calvin cycle and some

290
00:12:31,029 --> 00:12:28,249
reductive TCA cycle as well but once you

291
00:12:32,710 --> 00:12:31,039
get to the Luigi fluids a little bit

292
00:12:34,149 --> 00:12:32,720
deeper and there's more anaerobic fluid

293
00:12:36,429 --> 00:12:34,159
coming out then you start seeing

294
00:12:37,839 --> 00:12:36,439
anaerobic carbon fixation as well so

295
00:12:42,519 --> 00:12:37,849
we're kind of sampling that deeper

296
00:12:45,129 --> 00:12:42,529
subsurface organisms and then this chart

297
00:12:47,139 --> 00:12:45,139
is just a summary of those carbon

298
00:12:49,149 --> 00:12:47,149
fixation pathways the nitrogen

299
00:12:50,739 --> 00:12:49,159
metabolisms and sulphur metabolisms and

300
00:12:54,279 --> 00:12:50,749
then comparing those to the bottom

301
00:12:55,899 --> 00:12:54,289
seawater sample so this is the same that

302
00:12:58,210 --> 00:12:55,909
I just showed you just a second ago but

303
00:13:01,419 --> 00:12:58,220
I do want to point out that there's no

304
00:13:04,539 --> 00:13:01,429
Madana genesis potentially occurring in

305
00:13:06,039 --> 00:13:04,549
these sites we do have some genes in

306
00:13:07,629 --> 00:13:06,049
with Anna Genesis but there were no

307
00:13:09,999 --> 00:13:07,639
complete pathways out of a whole

308
00:13:12,429 --> 00:13:10,009
meta-genome we don't have the whole all

309
00:13:14,079 --> 00:13:12,439
of the genes so that's something to keep

310
00:13:15,670 --> 00:13:14,089
in mind

311
00:13:18,160 --> 00:13:15,680
and then you can see here there's a

312
00:13:19,840 --> 00:13:18,170
shift from the Calvin cycle and vitamin

313
00:13:22,480 --> 00:13:19,850

C water to these more anaerobic carbon

314
00:13:25,410 --> 00:13:22,490
fixation pathways in the low week event

315
00:13:27,759 --> 00:13:25,420
fluids nitrogen metabolism is really

316
00:13:30,309 --> 00:13:27,769
there's a higher potential for that as

317
00:13:33,100 --> 00:13:30,319
well in these low heat fluids and then

318
00:13:36,429 --> 00:13:33,110
the sulfur metabolism both bottom

319
00:13:42,610 --> 00:13:36,439
seawater and Loihi fluids have a high

320
00:13:43,869 --> 00:13:42,620
potential for that as well okay I just

321
00:13:45,999 --> 00:13:43,879
want to point out too that there are a

322
00:13:48,460 --> 00:13:46,009
lot of hydrogenases present in these

323
00:13:51,480 --> 00:13:48,470
fluids even though there is not a lot of

324
00:13:55,569 --> 00:13:51,490
hydrogen there's a high potential for

325
00:13:57,069 --> 00:13:55,579
hydrogen hydrogen utilization I has been

326
00:13:58,720 --> 00:13:57,079
pointed out to me that Meir profundus

327
00:13:59,829 --> 00:13:58,730
has a lot of these hydrogenases so I

328
00:14:02,499 --> 00:13:59,839
think it would be interesting to look

329
00:14:05,739 --> 00:14:02,509
and see if those are the organisms that

330
00:14:08,369 --> 00:14:05,749
are using these as well so our

331
00:14:10,749 --> 00:14:08,379
preliminary results are that I have

332
00:14:13,540 --> 00:14:10,759
metagenomes that show a potential for

333
00:14:15,280 --> 00:14:13,550
anaerobic carbon fixation and hydrogen a

334
00:14:17,499 --> 00:14:15,290
trophy in this low heat vent fluid

335
00:14:20,499 --> 00:14:17,509
community including the reductive TCA

336
00:14:23,499 --> 00:14:20,509
and with long dal pathway for heceta

337
00:14:25,090 --> 00:14:23,509
Genesis not methanogenesis that we have

338
00:14:27,059 --> 00:14:25,100

nitrogen and sulfur cycling that's

339
00:14:30,249 --> 00:14:27,069
potentially important in this community

340
00:14:33,249 --> 00:14:30,259
the cell density is really low we do

341
00:14:34,960 --> 00:14:33,259
have iron oxidizing bacteria present but

342
00:14:37,449 --> 00:14:34,970
it's not the majority of the community

343
00:14:40,329 --> 00:14:37,459
like we have in the mats and then I'm

344
00:14:44,139 --> 00:14:40,339
culturally sorry culturing organisms at

345
00:14:46,660 --> 00:14:44,149
the lab based on organisms that grow a

346
00:14:49,480 --> 00:14:46,670
lot mineral is like olivine iron and

347
00:14:51,040 --> 00:14:49,490
hydrogen and trying to determine who the

348
00:14:53,679 --> 00:14:51,050
autotrophs of that community are who's

349
00:14:57,579 --> 00:14:53,689
fixing carbon and then I have some more

350
00:15:02,259 --> 00:14:57,589
more experiments coming as well so for

351
00:15:04,929 --> 00:15:02,269
ocean worlds this Loihi site is it is a

352
00:15:07,049 --> 00:15:04,939
low energy system and there is evidence

353
00:15:09,179 --> 00:15:07,059
that there's oxygenated seawater

354
00:15:12,220 --> 00:15:09,189
circulating within the crust and that's

355
00:15:14,919 --> 00:15:12,230
being captured in that community so

356
00:15:19,329 --> 00:15:14,929
perhaps going deeper we might be able to

357
00:15:22,030 --> 00:15:19,339
get a more pure sample for ocean worlds

358
00:15:24,759 --> 00:15:22,040
and we already see evidence of anaerobic

359
00:15:26,710 --> 00:15:24,769
carbon fixation pathways and then we

360
00:15:27,580 --> 00:15:26,720
have some unusual organisms potentially

361
00:15:30,970 --> 00:15:27,590
using them

362
00:15:32,140 --> 00:15:30,980
so with that I would say thank you