

Study goals

- Obtain culture-based maintenance energy values for vent organisms
- Examine distribution of various autotrophic metabolic strategies at vent field site
- Compare predicted and actual habitability



1
00:00:10,700 --> 00:00:09,440
alright so I was saying I'm glad some

2
00:00:12,379 --> 00:00:10,710
talks this morning have done some of my

3
00:00:13,820 --> 00:00:12,389
prick work for me and explaining some of

4
00:00:15,890 --> 00:00:13,830
the concepts to which should make the

5
00:00:16,790 --> 00:00:15,900
skull a little faster but basically what

6
00:00:19,580 --> 00:00:16,800
I'm going to be talking to you about

7
00:00:21,589 --> 00:00:19,590
today is a energetic modeling approach

8
00:00:24,019 --> 00:00:21,599
to understanding habitability and

9
00:00:27,170 --> 00:00:24,029
microbial distribution and hydrothermal

10
00:00:30,050 --> 00:00:27,180
vent systems so we will talk about

11
00:00:32,030 --> 00:00:30,060
habitability in astrobiology a lot that

12
00:00:33,710 --> 00:00:32,040
habitability is something that we need

13
00:00:36,170 --> 00:00:33,720

to be able to quantify and when we're

14

00:00:37,490 --> 00:00:36,180

talking about microbial organisms we

15

00:00:40,180 --> 00:00:37,500

need to have a way to quantify

16

00:00:42,860 --> 00:00:40,190

environments that is not based on our

17

00:00:44,900 --> 00:00:42,870

preconceptions about habitability for

18

00:00:47,389 --> 00:00:44,910

instance we need to be able to decide

19

00:00:49,400 --> 00:00:47,399

whether this nice filled with the Sheep

20

00:00:52,450 --> 00:00:49,410

or this like smoke a hydrothermal vent

21

00:00:55,340 --> 00:00:52,460

is objectively and quantitatively

22

00:00:57,979 --> 00:00:55,350

habitable in different ways and the way

23

00:00:59,569 --> 00:00:57,989

that are we do this in my project as we

24

00:01:01,459 --> 00:00:59,579

look at energy availability because

25

00:01:03,110 --> 00:01:01,469

energy availability is a neutral

26

00:01:05,359 --> 00:01:03,120

determinant of habitability we're not

27

00:01:07,910 --> 00:01:05,369

thinking about and we're not comparing

28

00:01:09,560 --> 00:01:07,920

temperatures we're not just comparing

29

00:01:11,390 --> 00:01:09,570

the amount of energy available to

30

00:01:14,960 --> 00:01:11,400

organisms and the amount of energy they

31

00:01:16,940 --> 00:01:14,970

need to survive so the environment that

32

00:01:18,380 --> 00:01:16,950

I look at a deep sea hydrothermal vents

33

00:01:20,719 --> 00:01:18,390

so we had a couple of talks yesterday

34

00:01:22,429 --> 00:01:20,729

that talked about very alkaline

35

00:01:25,039 --> 00:01:22,439

hydrothermal vent systems and ones

36

00:01:27,560 --> 00:01:25,049

listed and I'm sort of Archaea notions

37

00:01:29,840 --> 00:01:27,570

but I'm looking at modern ones black

38

00:01:31,100 --> 00:01:29,850

smoke events so briefly for those of you

39

00:01:33,380 --> 00:01:31,110

who are unfamiliar with deep sea

40

00:01:35,749 --> 00:01:33,390

hydrothermal vent systems basically what

41

00:01:37,819 --> 00:01:35,759

happens is seawater is drawn down and

42

00:01:40,280 --> 00:01:37,829

percolates through the crust and where

43

00:01:42,469 --> 00:01:40,290

it becomes very hot very reduced and

44

00:01:44,660 --> 00:01:42,479

unvarying metallic and then it flows

45

00:01:46,640 --> 00:01:44,670

back up as hydrothermal discharge and it

46

00:01:48,260 --> 00:01:46,650

also mixes with seawater which is only

47

00:01:51,080 --> 00:01:48,270

in drawn down a little way into the

48

00:01:53,030 --> 00:01:51,090

crust and Vince both as black smoke a

49

00:01:55,730 --> 00:01:53,040

hydrothermal venting which creates this

50

00:01:58,069 --> 00:01:55,740

black hydrothermal plume where the hot

51
00:02:00,679 --> 00:01:58,079
reduced metallic fluid makes the cold

52
00:02:03,770 --> 00:02:00,689
oxidizing metal-poor seawater and iron

53
00:02:06,440 --> 00:02:03,780
sulfide specific precipitate out but it

54
00:02:08,330 --> 00:02:06,450
also vince's diffuse fluid down to 250

55
00:02:10,310 --> 00:02:08,340
degrees when it's being mixed with a lot

56
00:02:11,720 --> 00:02:10,320
of Swiss mixed with a lot of seawater so

57
00:02:14,059 --> 00:02:11,730
obviously everything that comes up there

58
00:02:16,400 --> 00:02:14,069
is being sterilized but microbes that

59
00:02:19,370 --> 00:02:16,410
live both in the vent community and the

60
00:02:21,110 --> 00:02:19,380
subsurface and can be

61
00:02:22,850 --> 00:02:21,120
pulled by sampling the diffuse finding

62
00:02:24,650 --> 00:02:22,860
with the floods a little cooler and the

63
00:02:27,170 --> 00:02:24,660

key thing about these systems as primary

64

00:02:29,450 --> 00:02:27,180

production is chemosynthetic so it's not

65

00:02:33,200 --> 00:02:29,460

based on photosynthesis it's based

66

00:02:35,390 --> 00:02:33,210

entirely on organisms microbes which are

67

00:02:37,820 --> 00:02:35,400

making the living off the chemical redox

68

00:02:39,140 --> 00:02:37,830

potential between the cold oxidizing

69

00:02:41,930 --> 00:02:39,150

seawater and the hot reducing

70

00:02:43,850 --> 00:02:41,940

hydrothermal fluid and on the ride is a

71

00:02:47,180 --> 00:02:43,860

like smoke a chimney so you have a

72

00:02:50,030 --> 00:02:47,190

pretty picture now at hydrothermal vent

73

00:02:52,250 --> 00:02:50,040

systems geochemist so not me can model

74

00:02:54,290 --> 00:02:52,260

energy availability to microbes for a

75

00:02:56,900 --> 00:02:54,300

number of different microbial metabolic

76
00:02:58,310 --> 00:02:56,910
strategies so this is an image from the

77
00:03:00,410 --> 00:02:58,320
column and shock which is a well-known

78
00:03:02,060 --> 00:03:00,420
pay for doing this and essentially what

79
00:03:04,070 --> 00:03:02,070
this showing you is over a range of

80
00:03:05,720 --> 00:03:04,080
temperatures the energy available and

81
00:03:07,970 --> 00:03:05,730
they're measuring it and calories per

82
00:03:09,560 --> 00:03:07,980
kilogram of vent fluid for a number of

83
00:03:11,600 --> 00:03:09,570
different metabolic strategies and

84
00:03:13,760 --> 00:03:11,610
methanogenesis iron reduction sulfur

85
00:03:15,860 --> 00:03:13,770
reduction and so forth changes over

86
00:03:18,460 --> 00:03:15,870
temperature so essentially at lower

87
00:03:21,140 --> 00:03:18,470
temperatures oxidation oxidation

88
00:03:22,430 --> 00:03:21,150

metabolisms are favorable and at higher

89

00:03:25,690 --> 00:03:22,440

temperatures filmer philocan

90

00:03:28,580 --> 00:03:25,700

hyperthermophilic ones reductive

91

00:03:32,210 --> 00:03:28,590

metabolisms are favorable and they have

92

00:03:33,920 --> 00:03:32,220

also looked at it over a binge chimney

93

00:03:35,900 --> 00:03:33,930

so this is mean to be a cross-section of

94

00:03:37,640 --> 00:03:35,910

eventually and they're predicting where

95

00:03:39,590 --> 00:03:37,650

different organisms would live based on

96

00:03:41,980 --> 00:03:39,600

the temperature and within this venture

97

00:03:44,360 --> 00:03:41,990

moni assuming that you have the same

98

00:03:46,790 --> 00:03:44,370

geochemical fluid available throughout

99

00:03:48,199 --> 00:03:46,800

the VIN chimney so essentially what

100

00:03:50,060 --> 00:03:48,209

they're saying is you can predict what

101

00:03:52,910 --> 00:03:50,070

should be living we're based on the

102

00:03:54,740 --> 00:03:52,920

geochemistry and the temperature however

103

00:03:56,570 --> 00:03:54,750

to understand what should be living

104

00:03:57,680 --> 00:03:56,580

we're based on energy availability we

105

00:03:59,750 --> 00:03:57,690

also need to know about energy

106

00:04:01,220 --> 00:03:59,760

requirements so there are two

107

00:04:02,720 --> 00:04:01,230

essentially there are two types of

108

00:04:04,280 --> 00:04:02,730

minimum energy requirement that we

109

00:04:06,440 --> 00:04:04,290

talked about in microbiology they've

110

00:04:09,080 --> 00:04:06,450

both broadly called maintenance energies

111

00:04:11,000 --> 00:04:09,090

but more specifically we have true

112

00:04:12,860 --> 00:04:11,010

maintenance energies and which is the

113

00:04:14,990 --> 00:04:12,870

energy required to maintain cellular

114

00:04:17,180 --> 00:04:15,000

function without growth so this is like

115

00:04:19,160 --> 00:04:17,190

maybe an organism in the permafrost its

116

00:04:20,990 --> 00:04:19,170

maintaining its osmotic balance it's

117

00:04:23,150 --> 00:04:21,000

repairing its DNA but it's not growing

118

00:04:25,520 --> 00:04:23,160

growth energy on the other hand is when

119

00:04:27,580 --> 00:04:25,530

an organism over time is able to both do

120

00:04:31,130 --> 00:04:27,590

all that work of maintaining itself and

121

00:04:32,540 --> 00:04:31,140

reproduce so these are two there so

122

00:04:33,439 --> 00:04:32,550

these are two different types of minimum

123

00:04:35,809 --> 00:04:33,449

growth requirement

124

00:04:38,959 --> 00:04:35,819

one sustains the organism and one allows

125

00:04:40,790 --> 00:04:38,969

the community to grow now maintenance

126

00:04:43,129 --> 00:04:40,800

energies also have a relationship to

127

00:04:44,570 --> 00:04:43,139

temperature so maintenance energies and

128

00:04:46,429 --> 00:04:44,580

here I'm talking specifically about the

129

00:04:49,249 --> 00:04:46,439

minimum maintenance requirement not in

130

00:04:51,019 --> 00:04:49,259

both of them I measured an energy per

131

00:04:52,969 --> 00:04:51,029

cell per time unit and these sort of

132

00:04:55,279 --> 00:04:52,979

studies so different studies will use

133

00:04:57,350 --> 00:04:55,289

different values for the energy and the

134

00:04:58,879 --> 00:04:57,360

time unit and sometimes they'll use gram

135

00:05:00,890 --> 00:04:58,889

of carbon instead of cell but it's

136

00:05:04,339 --> 00:05:00,900

basically energy per biomass per time

137

00:05:06,379 --> 00:05:04,349

unit and this is T adapted from t who

138

00:05:08,209 --> 00:05:06,389

said all which is the Beast no

139

00:05:10,369 --> 00:05:08,219

meta-analysis and maintenance energies

140

00:05:12,769 --> 00:05:10,379

and microorganisms and what it's showing

141

00:05:15,050 --> 00:05:12,779

us is and so they're doing kilojoules

142

00:05:17,390 --> 00:05:15,060

per gram of protein do I weight per day

143

00:05:18,890 --> 00:05:17,400

for maintenance energy and the

144

00:05:20,570 --> 00:05:18,900

aggression got over temperature so you

145

00:05:22,939 --> 00:05:20,580

can see first off the maintenance energy

146

00:05:24,589 --> 00:05:22,949

young Rises with temperature and the

147

00:05:26,779 --> 00:05:24,599

endless meter analysis and measured

148

00:05:28,879 --> 00:05:26,789

maintenance synergies and secondly that

149

00:05:31,299 --> 00:05:28,889

energy aerobic maintenance energy is a

150

00:05:33,469 --> 00:05:31,309

slightly higher than an aerobic however

151
00:05:35,209 --> 00:05:33,479
there's a couple with problems with this

152
00:05:38,209 --> 00:05:35,219
graph and for the purposes of deep-sea

153
00:05:40,429 --> 00:05:38,219
hydrothermal vents which that first if

154
00:05:43,760 --> 00:05:40,439
you see a little green circle those are

155
00:05:45,200 --> 00:05:43,770
the only two autotrophic anaerobes on

156
00:05:46,730 --> 00:05:45,210
the graph everything else is hit or a

157
00:05:49,070 --> 00:05:46,740
trophic and secondly if you look at the

158
00:05:51,619 --> 00:05:49,080
big blue circle almost everything in

159
00:05:53,119 --> 00:05:51,629
this meta-analysis goes between 20 and

160
00:05:55,010 --> 00:05:53,129
40 degrees if we want to look at

161
00:05:58,939 --> 00:05:55,020
thermophiles and hypothermia files the

162
00:06:00,860 --> 00:05:58,949
anaerobic I'm organism using reducing

163
00:06:02,689 --> 00:06:00,870

metabolisms at hydrothermal vents we

164

00:06:05,540 --> 00:06:02,699

basically only have those two dots in

165

00:06:08,029 --> 00:06:05,550

the green circle as data and so we want

166

00:06:09,800 --> 00:06:08,039

data that allows us to confirm whether

167

00:06:11,600 --> 00:06:09,810

the stream that t use is looking at

168

00:06:14,869 --> 00:06:11,610

actually exists for the organisms we're

169

00:06:17,689 --> 00:06:14,879

interested in through the more this

170

00:06:20,540 --> 00:06:17,699

graph on the writers from holo 2004 this

171

00:06:22,249 --> 00:06:20,550

is trying to look at methanogenesis and

172

00:06:24,110 --> 00:06:22,259

here they taking maintenance energies

173

00:06:26,719 --> 00:06:24,120

basing them on the theoretical from

174

00:06:29,059 --> 00:06:26,729

production energy required to produce

175

00:06:32,689 --> 00:06:29,069

ATP and that you can see that whole ER

176

00:06:35,149 --> 00:06:32,699

is giving us maintain synergies from

177

00:06:36,499 --> 00:06:35,159

minus 22 130 degrees which makes sense

178

00:06:38,719 --> 00:06:36,509

because over the boundaries of life

179

00:06:41,199 --> 00:06:38,729

right except that we don't actually have

180

00:06:43,819 --> 00:06:41,209

culture based data from microorganisms

181

00:06:45,259 --> 00:06:43,829

for anything like that and so that's

182

00:06:46,850 --> 00:06:45,269

that's pretty much entirely theoretical

183

00:06:48,589 --> 00:06:46,860

and what would be really nice

184

00:06:50,510 --> 00:06:48,599

if we had data that was actually based

185

00:06:52,279 --> 00:06:50,520

on growing organisms and measuring their

186

00:06:53,929 --> 00:06:52,289

maintenance energies to put into the

187

00:06:55,369 --> 00:06:53,939

geochemical models to predict where

188

00:06:57,709 --> 00:06:55,379

these things are going to live rather

189

00:07:01,820 --> 00:06:57,719

than just using the theoretical piece of

190

00:07:03,920 --> 00:07:01,830

data so this is basically my entire PhD

191

00:07:05,629 --> 00:07:03,930

the study and what we want to do is we

192

00:07:07,820 --> 00:07:05,639

want to obtain and culture based

193

00:07:10,040 --> 00:07:07,830

maintenance energy values by growing the

194

00:07:12,499 --> 00:07:10,050

organisms and pure culture in the lab we

195

00:07:13,760 --> 00:07:12,509

then want to examine the distribution of

196

00:07:15,469 --> 00:07:13,770

the organisms that we're measuring

197

00:07:17,929 --> 00:07:15,479

maintenance energy is for at higher

198

00:07:19,730 --> 00:07:17,939

thermal of insights and can be compared

199

00:07:21,649 --> 00:07:19,740

the predicted and actual habitability so

200

00:07:23,240 --> 00:07:21,659

give our values to geochemists get them

201
00:07:25,999 --> 00:07:23,250
to model where the organisms should be

202
00:07:29,269 --> 00:07:26,009
and see if we can lean them see that in

203
00:07:30,800 --> 00:07:29,279
data we get from the field side so the

204
00:07:32,959 --> 00:07:30,810
model organisms were using and the

205
00:07:34,519 --> 00:07:32,969
finnegans this is primarily because

206
00:07:36,950 --> 00:07:34,529
methanogens at least the ones we're

207
00:07:38,570 --> 00:07:36,960
looking at our one-trick pony at zuma

208
00:07:40,429 --> 00:07:38,580
philocan hyperthermophilic temperatures

209
00:07:41,899 --> 00:07:40,439
the only thing our methanogens are doing

210
00:07:43,939 --> 00:07:41,909
and thus we're looking at a restricted

211
00:07:45,830 --> 00:07:43,949
group of methanogens they are taking

212
00:07:47,540 --> 00:07:45,840
hydrogen they're taking co2 and now

213
00:07:49,010 --> 00:07:47,550

producing methane they're not using a

214

00:07:50,540 --> 00:07:49,020

seeder trophy they're not using any of

215

00:07:52,399 --> 00:07:50,550

the other weird methyl groups or

216

00:07:54,409 --> 00:07:52,409

anything we've doing one thing so it

217

00:07:56,240 --> 00:07:54,419

makes modeling there i'm energy so

218

00:07:58,459 --> 00:07:56,250

availability very easy because you only

219

00:08:00,740 --> 00:07:58,469

have to look at one reaction that one

220

00:08:02,510 --> 00:08:00,750

specific methanogenesis reaction instead

221

00:08:04,070 --> 00:08:02,520

of alternative metabolic strategies they

222

00:08:08,570 --> 00:08:04,080

might or might not be using and field

223

00:08:10,640 --> 00:08:08,580

conditions so this these two graphs are

224

00:08:12,860 --> 00:08:10,650

my growth energy data for two groups of

225

00:08:14,719 --> 00:08:12,870

methanogens the ones on the left asuma

226

00:08:16,209 --> 00:08:14,729

filip mosz elegans the methane of thermo

227

00:08:18,110 --> 00:08:16,219

cocci the ones on the writer

228

00:08:20,329 --> 00:08:18,120

hyperthermophilic methanogens the

229

00:08:22,700 --> 00:08:20,339

masonic older i which grow above 80

230

00:08:24,920 --> 00:08:22,710

degrees the thermophiles grow between 50

231

00:08:26,689 --> 00:08:24,930

and 80 degrees although these ones on

232

00:08:28,219 --> 00:08:26,699

the left all grow between about 50 and

233

00:08:30,769 --> 00:08:28,229

60 degrees at their optimum temperature

234

00:08:32,209 --> 00:08:30,779

and now these are growth energy is not

235

00:08:34,040 --> 00:08:32,219

maintain its energies this is sort of

236

00:08:36,380 --> 00:08:34,050

preliminary data so we're measuring the

237

00:08:38,689 --> 00:08:36,390

energy that they use when they grow

238

00:08:40,819 --> 00:08:38,699

instead of just maintaining themselves

239

00:08:43,040 --> 00:08:40,829

but you can see in immediately that

240

00:08:44,990 --> 00:08:43,050

apart from this one organism both the

241

00:08:46,939 --> 00:08:45,000

hyperthermophilic meth antigen and the

242

00:08:48,800 --> 00:08:46,949

thermophilic methanogens are these two

243

00:08:50,240 --> 00:08:48,810

graphs have the same scale they have

244

00:08:51,889 --> 00:08:50,250

roughly the same range of growth

245

00:08:53,630 --> 00:08:51,899

energies so the growth energies rise

246

00:08:55,189 --> 00:08:53,640

with temperature as they're growing at

247

00:08:56,930 --> 00:08:55,199

different temperatures but they're not

248

00:08:58,400 --> 00:08:56,940

hugely different even though this team

249

00:08:59,460 --> 00:08:58,410

this organism has a very different

250

00:09:01,680 --> 00:08:59,470

optimum temperature

251
00:09:03,210 --> 00:09:01,690
which is different to the sweet organisms

252
00:09:06,420 --> 00:09:03,220
with high optimum temperatures had

253
00:09:07,920 --> 00:09:06,430
higher maintenance energy so the next

254
00:09:09,510 --> 00:09:07,930
thing I want to do is measure the actual

255
00:09:10,770 --> 00:09:09,520
maintenance energies and the reason I'm

256
00:09:12,330 --> 00:09:10,780
doing that second is it's more difficult

257
00:09:14,610 --> 00:09:12,340
you have to grow the organisms and

258
00:09:16,470 --> 00:09:14,620
continuous chemostat culture on which

259
00:09:19,170 --> 00:09:16,480
when you're working with anaerobes grown

260
00:09:20,610 --> 00:09:19,180
in salt water at 80 degrees is somewhat

261
00:09:23,520 --> 00:09:20,620
difficult because they don't mess

262
00:09:26,190 --> 00:09:23,530
produce kemah stats to do that so and

263
00:09:27,630 --> 00:09:26,200

this is a graph from I forgot to put the

264

00:09:29,220 --> 00:09:27,640

attributions I'm a terrible person and

265

00:09:31,440 --> 00:09:29,230

this is a grab from holler and Jorgensen

266

00:09:33,150 --> 00:09:31,450

2013 and we're showing that what a

267

00:09:35,640 --> 00:09:33,160

continuous chemostat is doing you

268

00:09:37,230 --> 00:09:35,650

basically got an inflow stirs there's an

269

00:09:39,150 --> 00:09:37,240

outflow and that maintains the

270

00:09:41,130 --> 00:09:39,160

population and the chemostat of the same

271

00:09:43,890 --> 00:09:41,140

number so if you measure how much energy

272

00:09:45,480 --> 00:09:43,900

they're using then you can measure the

273

00:09:46,980 --> 00:09:45,490

minimum maintenance energy because the

274

00:09:49,680 --> 00:09:46,990

number of organisms and the chemostat

275

00:09:52,860 --> 00:09:49,690

never changes it sound so even if what

276

00:09:54,390 --> 00:09:52,870

some die and some grow for the total

277

00:09:56,490 --> 00:09:54,400

number of organisms you can average out

278

00:09:59,310 --> 00:09:56,500

and maintenance energy and this is from

279

00:10:00,810 --> 00:09:59,320

fido 1987 weird showing data were they

280

00:10:02,580 --> 00:10:00,820

doing the same thing they've got

281

00:10:04,380 --> 00:10:02,590

dilution rates for the chemostat they've

282

00:10:05,970 --> 00:10:04,390

got a production rate and they're

283

00:10:08,490 --> 00:10:05,980

graphing it out to get a maintenance

284

00:10:10,020 --> 00:10:08,500

energy measurement so this is what we

285

00:10:11,700 --> 00:10:10,030

want to do we want to grow organisms and

286

00:10:13,500 --> 00:10:11,710

a chemist at understood and conditions

287

00:10:14,730 --> 00:10:13,510

at a bunch of dilution rates we should

288

00:10:16,490 --> 00:10:14,740

be able to graph it and then get a

289

00:10:21,390 --> 00:10:16,500

maintenance energy from the intercept

290

00:10:22,920 --> 00:10:21,400

however this is by the way this is the

291

00:10:24,420 --> 00:10:22,930

chemist at i use and i just wanted to

292

00:10:26,220 --> 00:10:24,430

show you that because we can't buy one

293

00:10:27,840 --> 00:10:26,230

of these i have jury rigged it from

294

00:10:29,670 --> 00:10:27,850

things we had lying around the lab it's

295

00:10:31,770 --> 00:10:29,680

a big pyrox bottle which we put a heat

296

00:10:34,020 --> 00:10:31,780

jacket on this is actually a prebuilt

297

00:10:36,060 --> 00:10:34,030

some two liter bioreactor and then we

298

00:10:37,950 --> 00:10:36,070

hook them up with pumps and a pH thing

299

00:10:39,960 --> 00:10:37,960

then just hope none of it falls apart of

300

00:10:43,410 --> 00:10:39,970

breaks and it hasn't so far so I'm very

301

00:10:44,850 --> 00:10:43,420

relieved but this is the data I've got

302

00:10:46,710 --> 00:10:44,860

from my chemist a trans now I've only

303

00:10:48,480 --> 00:10:46,720

been doing these for two or three months

304

00:10:50,070 --> 00:10:48,490

so there's going to be a lot more data

305

00:10:51,570 --> 00:10:50,080

where this comes from but you can see

306

00:10:53,760 --> 00:10:51,580

immediately that I'm not really getting

307

00:10:55,440 --> 00:10:53,770

that same neat slope that they got now

308

00:10:57,180 --> 00:10:55,450

admittedly I've been growing than a

309

00:10:58,950 --> 00:10:57,190

different hydrogen concentrations in

310

00:11:01,350 --> 00:10:58,960

case that has an effect on the amount of

311

00:11:02,760 --> 00:11:01,360

energy they're using that it's pretty

312

00:11:04,770 --> 00:11:02,770

scattered they're not really in each

313

00:11:06,330 --> 00:11:04,780

slope and I think why this is is if you

314

00:11:08,160 --> 00:11:06,340

look at my hydrogen concentrations

315

00:11:10,350 --> 00:11:08,170

they're pretty low there's you know

316

00:11:12,870 --> 00:11:10,360

Michael moles per liter and these are

317

00:11:16,470 --> 00:11:12,880

produced by guessing it with between 30

318

00:11:19,020 --> 00:11:16,480

19 mils per minute of hydrogen if you go

319

00:11:21,330 --> 00:11:19,030

back too far dough and they don't have

320

00:11:23,010 --> 00:11:21,340

it here that they're using six or seven

321

00:11:24,930 --> 00:11:23,020

hundred mils a minute of hydrogen just

322

00:11:26,250 --> 00:11:24,940

truly immense quantities and I think

323

00:11:28,590 --> 00:11:26,260

what's happening is even though my

324

00:11:31,200 --> 00:11:28,600

hydrogen rates are comparable to what

325

00:11:34,020 --> 00:11:31,210

you would see in a hydrothermal vent it

326

00:11:35,910 --> 00:11:34,030

means that the organisms are not in

327

00:11:37,350 --> 00:11:35,920

there other studies organisms are next

328

00:11:38,730 --> 00:11:37,360

out there they have all the hydrogen

329

00:11:40,110 --> 00:11:38,740

they could need whereas of mine they

330

00:11:41,250 --> 00:11:40,120

might be restricted by hydrogen and

331

00:11:43,020 --> 00:11:41,260

that's why I'm not seeing the same

332

00:11:44,820 --> 00:11:43,030

relationship so we're going to have to

333

00:11:46,680 --> 00:11:44,830

work on basically finding out ways to

334

00:11:47,970 --> 00:11:46,690

produce the same data that other people

335

00:11:50,820 --> 00:11:47,980

who produce but the important thing

336

00:11:52,140 --> 00:11:50,830

right now is the system as up it runs I

337

00:11:54,240 --> 00:11:52,150

can measure thermophiles and

338

00:11:58,140 --> 00:11:54,250

hyperthermia files producing methane

339

00:11:59,880 --> 00:11:58,150

under these conditions so secondly we're

340

00:12:01,440 --> 00:11:59,890

also looking at collecting field data to

341

00:12:03,780 --> 00:12:01,450

make the comparisons when we have once

342

00:12:05,910 --> 00:12:03,790

we have the maintenance energy and we

343

00:12:07,230 --> 00:12:05,920

collect field data from axial volcano

344

00:12:09,330 --> 00:12:07,240

it's off the coast of oregon and

345

00:12:12,150 --> 00:12:09,340

washington on the Juan de Fuca Ridge we

346

00:12:14,430 --> 00:12:12,160

use Jason and remote operations

347

00:12:16,230 --> 00:12:14,440

submersible jason has a fluid collector

348

00:12:17,880 --> 00:12:16,240

attached to it which it sticks and to

349

00:12:19,410 --> 00:12:17,890

diffuse finding sites to collect fluid

350

00:12:21,270 --> 00:12:19,420

that we bring out to the surface to do

351
00:12:23,790 --> 00:12:21,280
culture dependent and our collaborators

352
00:12:25,710 --> 00:12:23,800
do culture independent and abundance and

353
00:12:28,530 --> 00:12:25,720
diversity analyses on the microbes that

354
00:12:31,260 --> 00:12:28,540
we find there so briefly this is from

355
00:12:33,180 --> 00:12:31,270
our field data from a trip last year we

356
00:12:34,980 --> 00:12:33,190
found that on the western side of the

357
00:12:36,450 --> 00:12:34,990
caldera which has a low hydrogen

358
00:12:38,340 --> 00:12:36,460
concentration there were no methanogens

359
00:12:40,500 --> 00:12:38,350
but their worth in the phila can

360
00:12:42,060 --> 00:12:40,510
hyperthermophilic heterotrophs so there

361
00:12:44,880 --> 00:12:42,070
are things living there we just didn't

362
00:12:47,430 --> 00:12:44,890
find any methanogens on the eastern side

363
00:12:49,470 --> 00:12:47,440

of the caldera where they have higher

364

00:12:51,660 --> 00:12:49,480

hydrogen concentrations we found

365

00:12:53,400 --> 00:12:51,670

Messenians at both hyperthermophilic and

366

00:12:55,710 --> 00:12:53,410

simmer falak temperatures and fewer

367

00:12:57,900 --> 00:12:55,720

heterotrophs and so we are seeing

368

00:13:00,200 --> 00:12:57,910

initially that on there is a there is

369

00:13:02,550 --> 00:13:00,210

basically a hydrogen concentration

370

00:13:05,280 --> 00:13:02,560

relationship between methanogens prism

371

00:13:08,160 --> 00:13:05,290

senders and n-methyl engine non prisons

372

00:13:09,960 --> 00:13:08,170

which can is consistent with data done

373

00:13:12,090 --> 00:13:09,970

from previous studies at the site so

374

00:13:14,040 --> 00:13:12,100

that bodes well for our heavy ability

375

00:13:16,590 --> 00:13:14,050

studies using the specific maintenance

376

00:13:18,150 --> 00:13:16,600

energies and in terms of future work we

377

00:13:20,610 --> 00:13:18,160

want to do a bunch more sampling at

378

00:13:23,250 --> 00:13:20,620

axial we're still waiting on data from

379

00:13:25,320 --> 00:13:23,260

our collaborators for the molecular data

380

00:13:26,079 --> 00:13:25,330

to look at them both knitted the

381

00:13:28,210 --> 00:13:26,089

messaging

382

00:13:30,069 --> 00:13:28,220

own genome amid a transcriptome and the

383

00:13:32,019 --> 00:13:30,079

geochemistry so the modelers can get to

384

00:13:33,160 --> 00:13:32,029

work I'm going to be spending the next

385

00:13:34,900 --> 00:13:33,170

two years basically getting the

386

00:13:36,970 --> 00:13:34,910

maintenance energy data and sorting all

387

00:13:38,319 --> 00:13:36,980

that out and thirdly I have a master's

388

00:13:39,850 --> 00:13:38,329

student working with me who's going to

389

00:13:42,610 --> 00:13:39,860

start looking at fire sulfate reduction

390

00:13:44,379 --> 00:13:42,620

so we can also move this modeling to

391

00:13:45,759 --> 00:13:44,389

other metabolisms apart from the Fenner

392

00:13:48,040 --> 00:13:45,769

genesis because we know there are fire

393

00:13:49,809 --> 00:13:48,050

sulfate reducers through the files at

394

00:13:51,549 --> 00:13:49,819

these events and we'll isolated them

395

00:13:53,889 --> 00:13:51,559

from there he can work with once we've

396

00:13:55,179 --> 00:13:53,899

isolated from the vents so I have hopes

397

00:13:57,059 --> 00:13:55,189

that that will produce some interest in

398

00:13:59,170 --> 00:13:57,069

comparisons with the methanogens and

399

00:14:01,449 --> 00:13:59,180

finally our like to think of my

400

00:14:02,980 --> 00:14:01,459

financial sponsors Iran and my lab and

401
00:14:04,449 --> 00:14:02,990
our collaborators who make all this

402
00:14:12,069 --> 00:14:04,459
possible by getting us the rest of the

403
00:14:25,119 --> 00:14:12,079
data thank you do we have any questions

404
00:14:27,790 --> 00:14:25,129
for see just a quick question are those

405
00:14:29,889 --> 00:14:27,800
though sulfate reducers one-trick ponies

406
00:14:31,360 --> 00:14:29,899
no they're not one trick ponies but we

407
00:14:34,119 --> 00:14:31,370
intend to grow them in conditions where

408
00:14:36,040 --> 00:14:34,129
they don't have the other things too to

409
00:14:40,749 --> 00:14:36,050
reduce so mostly those organisms reduce

410
00:14:42,100 --> 00:14:40,759
thiosulfate also sulfur sulfite a couple

411
00:14:47,259 --> 00:14:42,110
of other sulfur related things but we

412
00:14:49,960 --> 00:14:47,269
only give them toe sulfate hi great talk

413
00:14:51,639 --> 00:14:49,970

I was just curious if in addition to

414

00:14:54,639 --> 00:14:51,649

looking at the maintenance energy you

415

00:14:57,939 --> 00:14:54,649

put or I've been thinking about looking

416

00:14:59,230 --> 00:14:57,949

at also some of the other parameters

417

00:15:01,119 --> 00:14:59,240

that go into modeling like half

418

00:15:02,319 --> 00:15:01,129

saturation constants for nutrients or

419

00:15:03,819 --> 00:15:02,329

are you just focusing on maintenance

420

00:15:05,710 --> 00:15:03,829

industry for right now no we're also

421

00:15:07,989 --> 00:15:05,720

looking at the half saturation constants

422

00:15:09,280 --> 00:15:07,999

and I don't hit the ground CD really yet

423

00:15:10,689 --> 00:15:09,290

but we're working on taking the data

424

00:15:12,369 --> 00:15:10,699

with God and putting into Michaela's

425

00:15:17,199 --> 00:15:12,379

Minton and lineweaver-burk plot sand

426

00:15:21,639 --> 00:15:17,209

looking at those things absolutely any

427

00:15:23,400 --> 00:15:21,649

other questions ok let's think here