



ABSciCON 2017

MESA, ARIZONA

1
00:00:12,250 --> 00:00:06,150

you

2
00:00:16,810 --> 00:00:14,430

[Music]

3
00:00:18,700 --> 00:00:16,820

okay Thank You Beth and Alexis for the

4
00:00:20,170 --> 00:00:18,710

invitation to be here you'll probably

5
00:00:21,400 --> 00:00:20,180

recognize the diagram on the left I

6
00:00:23,260 --> 00:00:21,410

couldn't resist putting it up because

7
00:00:24,519 --> 00:00:23,270

that's probably as an oceanographer that

8
00:00:26,470 --> 00:00:24,529

diagram more than anything else is what

9
00:00:28,450 --> 00:00:26,480

lured me into astrobiology about 15

10
00:00:30,160 --> 00:00:28,460

years ago and what I'm gonna talk about

11
00:00:32,439 --> 00:00:30,170

today is a new piece our program we just

12
00:00:34,990 --> 00:00:32,449

kicked off last year of the current best

13
00:00:37,840 --> 00:00:35,000

efforts amongst the a combined ocean and

14

00:00:38,680 --> 00:00:37,850

planetary science team from mostly from

15

00:00:41,470 --> 00:00:38,690

Woods Hole and JPL

16

00:00:44,200 --> 00:00:41,480

I've actually how to try and convert a

17

00:00:45,280 --> 00:00:44,210

nice idea into what's the current state

18

00:00:46,630 --> 00:00:45,290

of the art of how would you actually go

19

00:00:48,040 --> 00:00:46,640

and do that kind of thing if you wanted

20

00:00:50,920 --> 00:00:48,050

to go to an ice-covered ocean and study

21

00:00:52,060 --> 00:00:50,930

it so this is work funded by NASA but

22

00:00:53,290 --> 00:00:52,070

the robot that we're actually using

23

00:00:55,150 --> 00:00:53,300

wouldn't have been possible if we

24

00:00:57,130 --> 00:00:55,160

haven't actually had NSF pay for it and

25

00:01:01,060 --> 00:00:57,140

they were funders have learn how to use

26

00:01:02,619 --> 00:01:01,070

it without losing it and breaking it so

27

00:01:04,329 --> 00:01:02,629

here's the concept basically what we

28

00:01:06,400 --> 00:01:04,339

wanted to do for our own oceans which

29

00:01:07,800 --> 00:01:06,410

are interesting for their own right even

30

00:01:10,029 --> 00:01:07,810

without the astrobiological product

31

00:01:11,620 --> 00:01:10,039

credentials would be if you actually

32

00:01:13,450 --> 00:01:11,630

want to go study something in detail on

33

00:01:14,740 --> 00:01:13,460

the sea floor in the Arctic Ocean you

34

00:01:16,510 --> 00:01:14,750

can wait till everything freezes over

35

00:01:18,730 --> 00:01:16,520

like we did in September or October of

36

00:01:20,140 --> 00:01:18,740

last year and you get 100% ice cover but

37

00:01:21,880 --> 00:01:20,150

the trouble is the ship then becomes

38

00:01:23,320 --> 00:01:21,890

stationary compared to the ice but both

39

00:01:25,240 --> 00:01:23,330

the ship and the ice are still

40

00:01:28,030 --> 00:01:25,250

continuously moving compared to the

41

00:01:29,170 --> 00:01:28,040

solid shell of the earth underneath so

42

00:01:30,399 --> 00:01:29,180

if there's a particular place on the

43

00:01:32,170 --> 00:01:30,409

earth on the sea floor that you want to

44

00:01:33,730 --> 00:01:32,180

go and study in detail you can't

45

00:01:35,350 --> 00:01:33,740

actually hang around there for hours at

46

00:01:37,330 --> 00:01:35,360

a time if everything above you is moving

47

00:01:39,039 --> 00:01:37,340

at a mile or two an hour but basically

48

00:01:40,480 --> 00:01:39,049

by the end of the day you're on your

49

00:01:42,550 --> 00:01:40,490

some tens of kilometers away from where

50

00:01:43,929 --> 00:01:42,560

you need to be so that was the vision we

51
00:01:45,219 --> 00:01:43,939
had was to have a vehicle that you can

52
00:01:47,649 --> 00:01:45,229
actually deploy under the ice and

53
00:01:49,420 --> 00:01:47,659
exactly be free swimming in autonomous

54
00:01:50,620 --> 00:01:49,430
mode but it could also be something

55
00:01:52,060 --> 00:01:50,630
where you could actually keep humans in

56
00:01:54,249 --> 00:01:52,070
the loop for the most detailed stuff you

57
00:01:55,899 --> 00:01:54,259
want to do and we do that by using a

58
00:01:57,100 --> 00:01:55,909
single optical fiber about twice the

59
00:01:59,350 --> 00:01:57,110
thickness of a human hair

60
00:02:01,060 --> 00:01:59,360
we're about 20 kilometers worth of that

61
00:02:03,100 --> 00:02:01,070
tether can be rolled up in something the

62
00:02:04,600 --> 00:02:03,110
signs of a large roll of duct tape so

63
00:02:06,850 --> 00:02:04,610

basically what it allows you to do is to

64

00:02:08,740 --> 00:02:06,860

completely keep all the communication

65

00:02:10,300 --> 00:02:08,750

with the vehicle it's basically a

66

00:02:11,259 --> 00:02:10,310

battery powered vehicle so it can

67

00:02:13,870 --> 00:02:11,269

basically keep going as long as the

68

00:02:16,660 --> 00:02:13,880

batteries last and the ship can actually

69

00:02:18,160 --> 00:02:16,670

go wherever you like the only key thing

70

00:02:19,150 --> 00:02:18,170

then is somehow the ship and the vehicle

71

00:02:21,809 --> 00:02:19,160

have to meet up again at the end of the

72

00:02:25,319 --> 00:02:21,819

day so

73

00:02:26,880 --> 00:02:25,329

the place we took it to was 287 degrees

74

00:02:28,289 --> 00:02:26,890

north in the Arctic about 200 miles

75

00:02:30,509 --> 00:02:28,299

south of the North Pole

76

00:02:31,800 --> 00:02:30,519

last September and October and in

77

00:02:33,240 --> 00:02:31,810

particular we went to this area so

78

00:02:34,440 --> 00:02:33,250

here's the Cackles Ridge which is a

79

00:02:36,179 --> 00:02:34,450

mid-ocean ridge which can host

80

00:02:37,500 --> 00:02:36,189

hydrothermal activity and they've been

81

00:02:40,710 --> 00:02:37,510

chemical indications there were such

82

00:02:42,089 --> 00:02:40,720

things in this area the vehicle we had

83

00:02:43,979 --> 00:02:42,099

in its first version is only been

84

00:02:45,330 --> 00:02:43,989

developed go to 2,000 meters because it

85

00:02:47,879 --> 00:02:45,340

wasn't really designed to be doing

86

00:02:49,619 --> 00:02:47,889

seafloor hydrothermal exploration but

87

00:02:51,030 --> 00:02:49,629

the area we went to here was this inside

88

00:02:53,459 --> 00:02:51,040

quarter high because based on the

89

00:02:54,960 --> 00:02:53,469

bathymetric maps it was the closest

90

00:02:56,550 --> 00:02:54,970

thing we had to the kind of geologic

91

00:02:58,379 --> 00:02:56,560

setting for the lost city hydrothermal

92

00:02:59,879 --> 00:02:58,389

field if you know about it or LaVon BAM

93

00:03:01,800 --> 00:02:59,889

hydrothermal fields are places where you

94

00:03:04,520 --> 00:03:01,810

can have tectonic lis hosted and

95

00:03:07,349 --> 00:03:04,530

cependant ization cependant izing or

96

00:03:09,960 --> 00:03:07,359

serpentinization influenced hydrothermal

97

00:03:12,059 --> 00:03:09,970

systems on the seafloor so our hope was

98

00:03:13,440 --> 00:03:12,069

that we could go up to this area search

99

00:03:15,509 --> 00:03:13,450

for the right chemical signals in this

100

00:03:18,920 --> 00:03:15,519

area in autonomous mode track down

101
00:03:22,830 --> 00:03:18,930
sources to the seafloor and go find

102
00:03:25,500 --> 00:03:22,840
cependant ice related ecosystems on the

103
00:03:27,119 --> 00:03:25,510
Tees obligate study with the vehicle so

104
00:03:29,369 --> 00:03:27,129
you enter this area here's that summit

105
00:03:31,469 --> 00:03:29,379
in detail here's where we did a UV based

106
00:03:33,089 --> 00:03:31,479
mapping is what 100% ice cover looks

107
00:03:35,849 --> 00:03:33,099
like so the cartoon before we've made

108
00:03:37,409 --> 00:03:35,859
that part real already there's the ship

109
00:03:39,210 --> 00:03:37,419
as filmed from the helicopter in the

110
00:03:40,500 --> 00:03:39,220
first month before the Sun went down and

111
00:03:43,409 --> 00:03:40,510
we could actually still fly the

112
00:03:45,539 --> 00:03:43,419
helicopter and when we got there

113
00:03:47,159 --> 00:03:45,549

unfortunately or fortunately depending

114

00:03:48,689 --> 00:03:47,169

on which way you look at it we did find

115

00:03:51,210 --> 00:03:48,699

an oasis for life but it had nothing to

116

00:03:52,949 --> 00:03:51,220

do with serpent amazing fluid flow so a

117

00:03:54,719 --> 00:03:52,959

phrase I picked up from the Europa

118

00:03:56,069 --> 00:03:54,729

Lander Town Hall on Sunday was there was

119

00:03:57,990 --> 00:03:56,079

nothing wrong with the technology here

120

00:03:59,819 --> 00:03:58,000

just like the Viking mission it wasn't

121

00:04:01,020 --> 00:03:59,829

our fault that nature conspired not to

122

00:04:03,059 --> 00:04:01,030

put the right stuff in front of the

123

00:04:04,800 --> 00:04:03,069

vehicle while we were there but where we

124

00:04:06,539 --> 00:04:04,810

went to was the only place that was

125

00:04:08,819 --> 00:04:06,549

shallow enough for this vehicle to work

126
00:04:11,580 --> 00:04:08,829
on currently and this is a place that

127
00:04:13,439 --> 00:04:11,590
was teeming with life but it wasn't

128
00:04:16,110 --> 00:04:13,449
actually teeming with Sabine demising

129
00:04:17,939 --> 00:04:16,120
seafloor fluid flow what actually had

130
00:04:19,289 --> 00:04:17,949
instead was the whole area we couldn't

131
00:04:21,149 --> 00:04:19,299
actually find any rock in our camera

132
00:04:22,649 --> 00:04:21,159
surveys or we could actually find with

133
00:04:24,600 --> 00:04:22,659
these giant sponges the large ones here

134
00:04:26,219 --> 00:04:24,610
about a meter across so it's basically a

135
00:04:28,620 --> 00:04:26,229
continuous spectrum from tiny little

136
00:04:30,690 --> 00:04:28,630
baby giant sponges to fully grown giant

137
00:04:32,190 --> 00:04:30,700
sponges to the matrix in between which

138
00:04:34,260 --> 00:04:32,200

was actually the mush left behind when

139

00:04:35,279 --> 00:04:34,270

giant sponges had fallen apart so there

140

00:04:37,980 --> 00:04:35,289

was actually no rock

141

00:04:40,350 --> 00:04:37,990

crop in some thousands and thousands of

142

00:04:41,850 --> 00:04:40,360

photographs what we actually had instead

143

00:04:43,379 --> 00:04:41,860

was we did actually find little whiffs

144

00:04:44,639 --> 00:04:43,389

every now and then on our redox sensor

145

00:04:46,049 --> 00:04:44,649

that was suggesting there was something

146

00:04:47,790 --> 00:04:46,059

team has sent it setting in the area

147

00:04:49,739 --> 00:04:47,800

nothing that was indicative of fluid

148

00:04:57,629 --> 00:04:49,749

flow when he said what we found was

149

00:05:02,969 --> 00:04:57,639

sorry I when we go back one need to go

150

00:05:05,299 --> 00:05:02,979

back to what we found were in the

151
00:05:09,089 --> 00:05:05,309
sponges because they were expensive over

152
00:05:10,649 --> 00:05:09,099
10 miles or so that there was at least a

153
00:05:12,809 --> 00:05:10,659
subset of them that were basically

154
00:05:13,829 --> 00:05:12,819
rotting away on the seafloor and so you

155
00:05:15,869 --> 00:05:13,839
actually have these things so we

156
00:05:17,969 --> 00:05:15,879
actually have these these maps of

157
00:05:19,469 --> 00:05:17,979
microbial filament that animals were

158
00:05:20,670 --> 00:05:19,479
gathering around and when you zoom in on

159
00:05:22,589 --> 00:05:20,680
them we actually could actually film

160
00:05:24,719 --> 00:05:22,599
these things with these shrimp actually

161
00:05:26,219 --> 00:05:24,729
grazing on the microbial filaments so we

162
00:05:27,689 --> 00:05:26,229
had a nice little human synthetic food

163
00:05:29,070 --> 00:05:27,699

chain at the bottom of an ice-covered

164

00:05:30,659 --> 00:05:29,080

oceans that's all great but it's got

165

00:05:36,059 --> 00:05:30,669

nothing to do with serpentinization so I

166

00:05:37,799 --> 00:05:36,069

should move on so we had a plan B had a

167

00:05:38,850 --> 00:05:37,809

fallback which was here's the sea mount

168

00:05:40,529 --> 00:05:38,860

we were working on where we were just

169

00:05:42,749 --> 00:05:40,539

seeing that stuff oh and interestingly

170

00:05:43,889 --> 00:05:42,759

in my mind while I was filming that

171

00:05:46,110 --> 00:05:43,899

stuff I was ooming and doing all this

172

00:05:47,579 --> 00:05:46,120

detail and it was only a squid somebody

173

00:05:49,019 --> 00:05:47,589

pointed out that at the time I was doing

174

00:05:50,399 --> 00:05:49,029

that I was actually three miles away and

175

00:05:52,019 --> 00:05:50,409

drifting backwards away from the vent

176

00:05:53,399 --> 00:05:52,029

site that where the ship was it was

177

00:05:55,320 --> 00:05:53,409

doing all that stuff was a long way away

178

00:05:56,489 --> 00:05:55,330

and at the end of the sequence there was

179

00:05:58,259 --> 00:05:56,499

a time we had to pick up the ROV and

180

00:06:03,299 --> 00:05:58,269

skedaddle to catch back up at the ship

181

00:06:05,519 --> 00:06:03,309

and come back home Bob bottom trouble

182

00:06:06,809 --> 00:06:05,529

Plan B for the program was actually that

183

00:06:08,070 --> 00:06:06,819

there was another volcanic Ridge down

184

00:06:09,389 --> 00:06:08,080

here about three and a half thousand

185

00:06:11,639 --> 00:06:09,399

meters on the axis of the Rift Valley

186

00:06:13,109 --> 00:06:11,649

that we could go and study we couldn't

187

00:06:14,790 --> 00:06:13,119

do it with the ROV we could go back to

188

00:06:16,049 --> 00:06:14,800

what I started out my career doing 30

189

00:06:18,239 --> 00:06:16,059

years ago and I thought I'd given up

190

00:06:19,529 --> 00:06:18,249

forever which is lowering conventional

191

00:06:21,059 --> 00:06:19,539

CTD rosettes these are basically

192

00:06:23,070 --> 00:06:21,069

instrument packages you lower on a wire

193

00:06:24,209 --> 00:06:23,080

directly below the ship it has in situ

194

00:06:25,499 --> 00:06:24,219

sensors that can tell you something

195

00:06:27,509 --> 00:06:25,509

about the chemistry the water column

196

00:06:30,509 --> 00:06:27,519

that can tell you where to take your

197

00:06:32,549 --> 00:06:30,519

water samples from and in a normal ocean

198

00:06:33,959 --> 00:06:32,559

that's great in an ice-covered ocean you

199

00:06:35,459 --> 00:06:33,969

have this problem that basically where

200

00:06:37,019 --> 00:06:35,469

you get your samples from is then at the

201
00:06:38,969 --> 00:06:37,029
mercy of the elements of exactly where

202
00:06:41,219 --> 00:06:38,979
the ship and the ice moved to and where

203
00:06:43,529 --> 00:06:41,229
the wind changes so we knew we had this

204
00:06:45,869 --> 00:06:43,539
volcanic target here and over time and

205
00:06:47,220 --> 00:06:45,879
perseverance and some good judgment and

206
00:06:48,570 --> 00:06:47,230
some bad judgment

207
00:06:49,950 --> 00:06:48,580
then some of the time we actually got

208
00:06:51,150 --> 00:06:49,960
data in the area we wanted to and in

209
00:06:52,740 --> 00:06:51,160
fact we were actually able to narrow

210
00:06:54,690 --> 00:06:52,750
down exactly where those venting must be

211
00:06:56,310 --> 00:06:54,700
coming from from this volcanic Ridge at

212
00:06:57,450 --> 00:06:56,320
three and a half thousand meters to the

213
00:06:59,580 --> 00:06:57,460

level where we actually were able to

214

00:07:01,410 --> 00:06:59,590

intercept the rising stem of the plume

215

00:07:02,910 --> 00:07:01,420

coming up of the source so we probably

216

00:07:05,520 --> 00:07:02,920

know where the site is to about 100

217

00:07:07,230 --> 00:07:05,530

meters or so so we don't have pretty

218

00:07:09,210 --> 00:07:07,240

pictures of what's living down there at

219

00:07:10,740 --> 00:07:09,220

that second site but what we do have is

220

00:07:12,270 --> 00:07:10,750

a lot of chemical information about what

221

00:07:14,850 --> 00:07:12,280

the source function must be or what the

222

00:07:15,960 --> 00:07:14,860

source system must be like and the first

223

00:07:17,730 --> 00:07:15,970

thing that got us excited is we were

224

00:07:18,780 --> 00:07:17,740

doing shipboard chemical analyses and we

225

00:07:20,760 --> 00:07:18,790

found there were very high methane

226

00:07:22,110 --> 00:07:20,770

concentrations in these system so we

227

00:07:23,520 --> 00:07:22,120

weren't expecting that because we had

228

00:07:26,250 --> 00:07:23,530

some camera tows over the area as well

229

00:07:27,990 --> 00:07:26,260

all we saw was a basalt hosted volcanic

230

00:07:29,550 --> 00:07:28,000

Ridge so we were expecting this to be

231

00:07:31,260 --> 00:07:29,560

very boring I was expecting not have

232

00:07:33,150 --> 00:07:31,270

anything interesting enough for this

233

00:07:35,460 --> 00:07:33,160

session from the second half of what we

234

00:07:36,780 --> 00:07:35,470

did on our cruise instead we found these

235

00:07:38,820 --> 00:07:36,790

very high hydrogen methane

236

00:07:40,260 --> 00:07:38,830

concentrations and then what we also

237

00:07:42,390 --> 00:07:40,270

found was that for the highest

238

00:07:44,340 --> 00:07:42,400

concentration samples we also had very

239

00:07:46,500 --> 00:07:44,350

high hydrogen concentrations as well and

240

00:07:47,910 --> 00:07:46,510

about a 1 to 1 ratio and it's only as

241

00:07:49,500 --> 00:07:47,920

you travel further away in the flume

242

00:07:51,660 --> 00:07:49,510

which is probably only as the order of a

243

00:07:52,770 --> 00:07:51,670

kilometer or so then you get very rapid

244

00:07:54,690 --> 00:07:52,780

removal of the hydrogen the hydrogen

245

00:07:57,120 --> 00:07:54,700

doesn't persist in the water column the

246

00:07:58,590 --> 00:07:57,130

methane does so you get this nice linear

247

00:07:59,820 --> 00:07:58,600

correlation with temperature anomalies

248

00:08:03,180 --> 00:07:59,830

the temperature is a nice conservative

249

00:08:04,560 --> 00:08:03,190

physical tracer over the period of what

250

00:08:06,420 --> 00:08:04,570

we would imagine to be days and

251
00:08:08,580 --> 00:08:06,430
kilometers for the dispersion of this

252
00:08:10,890 --> 00:08:08,590
plume so basically the sample taken

253
00:08:12,720 --> 00:08:10,900
throughout the survey area all compiled

254
00:08:15,240 --> 00:08:12,730
onto a single plot the methane is

255
00:08:17,400 --> 00:08:15,250
relatively sluggishly an unreactive the

256
00:08:19,320 --> 00:08:17,410
hydrogen by contrast is much more

257
00:08:21,030 --> 00:08:19,330
reactive and in fact we've actually had

258
00:08:22,830 --> 00:08:21,040
some anti boat uses the collaborator on

259
00:08:24,150 --> 00:08:22,840
here her group in the operative Agra

260
00:08:25,950 --> 00:08:24,160
Institute have been doing microbial

261
00:08:27,180 --> 00:08:25,960
incubation experiments and they have

262
00:08:28,680 --> 00:08:27,190
good evidence that these are actually

263
00:08:30,270 --> 00:08:28,690

it's hydrogen there are hydrogen

264

00:08:31,830 --> 00:08:30,280

oxidizing while hydrogen consuming

265

00:08:33,240 --> 00:08:31,840

microbes in these plume waters that we

266

00:08:34,589 --> 00:08:33,250

collected and that's actually what's

267

00:08:36,330 --> 00:08:34,599

responsible for it it's not an inorganic

268

00:08:40,589 --> 00:08:36,340

process it's a microbial immediated

269

00:08:42,450 --> 00:08:40,599

removal of the hydrogen so that's pretty

270

00:08:44,130 --> 00:08:42,460

cool so we think we've got a hydrogen

271

00:08:45,900 --> 00:08:44,140

rich methane rich hydrothermal vent on

272

00:08:47,280 --> 00:08:45,910

the seafloor the other thing we realize

273

00:08:48,960 --> 00:08:47,290

by looking at the in situ sensors

274

00:08:50,520 --> 00:08:48,970

however is it's not a conventional black

275

00:08:52,620 --> 00:08:50,530

smoker high temperature hydrothermal

276

00:08:54,090 --> 00:08:52,630

field as we got very close to the source

277

00:08:55,800 --> 00:08:54,100

we found our redox anomalies where we

278

00:08:56,160 --> 00:08:55,810

have the freshest samples right over the

279

00:08:57,870 --> 00:08:56,170

source

280

00:09:00,090 --> 00:08:57,880

we're actually relatively low in

281

00:09:00,800 --> 00:09:00,100

particulate material so have material

282

00:09:02,360 --> 00:09:00,810

that was fairly low

283

00:09:04,160 --> 00:09:02,370

in particular concentration and as the

284

00:09:06,019 --> 00:09:04,170

plume dispersed further afield the

285

00:09:08,150 --> 00:09:06,029

particular concentrations increase and

286

00:09:09,560 --> 00:09:08,160

they grew in so we actually have some

287

00:09:10,640 --> 00:09:09,570

that particulate material we're still

288

00:09:13,280 --> 00:09:10,650

working on it there are two mechanisms

289

00:09:14,690 --> 00:09:13,290

we can imagine of how that worked one is

290

00:09:15,530 --> 00:09:14,700

that it could be in microbial activity

291

00:09:17,300 --> 00:09:15,540

and what you're actually doing is

292

00:09:18,680 --> 00:09:17,310

increasing microbial cell abundance but

293

00:09:20,000 --> 00:09:18,690

these are over very short length scales

294

00:09:22,010 --> 00:09:20,010

of a kilometer and probably not much

295

00:09:23,720 --> 00:09:22,020

time the other thing that I think is

296

00:09:25,880 --> 00:09:23,730

more plausible is we have a system

297

00:09:27,710 --> 00:09:25,890

that's not very rich in hydrogen sulfide

298

00:09:28,940 --> 00:09:27,720

but it is rich in iron which would fit

299

00:09:30,440 --> 00:09:28,950

with other sites we've found that have

300

00:09:32,269 --> 00:09:30,450

high hydrogen and high methane in the

301

00:09:34,370 --> 00:09:32,279

sea floor and that that iron the

302

00:09:36,170 --> 00:09:34,380

oxidation because the Arctic is a fairly

303

00:09:37,640 --> 00:09:36,180

isolated but ocean basin and quite

304

00:09:40,040 --> 00:09:37,650

sluggish that the rates of iron

305

00:09:41,690 --> 00:09:40,050

oxidation the kinetics are quite slow so

306

00:09:42,920 --> 00:09:41,700

the time it takes for an hour or so for

307

00:09:45,530 --> 00:09:42,930

the material to get from the sea floor

308

00:09:47,810 --> 00:09:45,540

up into the plume height in this area is

309

00:09:49,310 --> 00:09:47,820

only the order of an hour or so the iron

310

00:09:52,040 --> 00:09:49,320

oxidation kinetics may well be that the

311

00:09:53,510 --> 00:09:52,050

iron is then growing in so what I'd like

312

00:09:54,860 --> 00:09:53,520

to do now is just ask you to close your

313

00:09:56,630 --> 00:09:54,870

eyes for a moment and imagine what a

314

00:09:59,090 --> 00:09:56,640

vent site like that would look like so I

315

00:10:00,260 --> 00:09:59,100

want you to imagine a hot vent site at

316

00:10:01,670 --> 00:10:00,270

the bottom of the sea floor that's point

317

00:10:03,470 --> 00:10:01,680

enough to kick a plume up into the water

318

00:10:05,090 --> 00:10:03,480

column but it's got clear fluids when it

319

00:10:06,829 --> 00:10:05,100

comes up the seafloor and if you open

320

00:10:08,480 --> 00:10:06,839

your eyes here's what you imagined well

321

00:10:10,460 --> 00:10:08,490

done you made it happen

322

00:10:12,079 --> 00:10:10,470

you made it true so this is actually a

323

00:10:14,660 --> 00:10:12,089

von vamp hydrothermal field from the mid

324

00:10:16,790 --> 00:10:14,670

came and rised which I actually very I

325

00:10:17,930 --> 00:10:16,800

can't often believe when I actually I

326

00:10:20,030 --> 00:10:17,940

never really believed it when my

327

00:10:21,560 --> 00:10:20,040

proposals come true but back in the mid

328

00:10:22,760 --> 00:10:21,570

two thousands Ikey wrote a proposal so

329

00:10:24,140 --> 00:10:22,770

no wonder they go to the Cayman rides

330

00:10:25,579 --> 00:10:24,150

because it would be great preparation

331

00:10:27,290 --> 00:10:25,589

for the Arctic because it's the one

332

00:10:28,610 --> 00:10:27,300

place where we go and do everything else

333

00:10:30,110 --> 00:10:28,620

that we'd expect to find in the Arctic

334

00:10:31,970 --> 00:10:30,120

apart from have the ice in the way and

335

00:10:34,160 --> 00:10:31,980

so we found this site the von dam

336

00:10:35,420 --> 00:10:34,170

hydrothermal field which is pretty cool

337

00:10:37,250 --> 00:10:35,430

because that was the work that Jill

338

00:10:38,690 --> 00:10:37,260

McDermott did for her PhD with jeff

339

00:10:40,640 --> 00:10:38,700

seawater than me was on those samples

340

00:10:42,620 --> 00:10:40,650

was proven there were two different

341

00:10:43,820 --> 00:10:42,630

pathways for abiotic organic synthesis

342

00:10:45,800 --> 00:10:43,830

that you could actually get out of that

343

00:10:47,930 --> 00:10:45,810

system there's a hybrid system with

344

00:10:49,520 --> 00:10:47,940

ultramafic rocks but also some Gaborik

345

00:10:51,170 --> 00:10:49,530

material in there as well which gives

346

00:10:52,370 --> 00:10:51,180

you both energy and a bit of extra

347

00:10:54,949 --> 00:10:52,380

silica that you wouldn't have from a

348

00:10:56,210 --> 00:10:54,959

purely serpent amazing system so you

349

00:10:58,340 --> 00:10:56,220

might think of that as being a really

350

00:11:00,079 --> 00:10:58,350

cool place so do I think that's what's

351
00:11:04,000 --> 00:11:00,089
happening on the bottom of the Arctic no

352
00:11:07,430 --> 00:11:04,010
suddenly not that site is actually set

353
00:11:09,260 --> 00:11:07,440
right up on an ultramatic hilltop so the

354
00:11:12,050 --> 00:11:09,270
von Dam hydrothermal field is actually

355
00:11:13,490 --> 00:11:12,060
sitting in a system just like the kara

356
00:11:14,480 --> 00:11:13,500
succeed mount we first went to the one

357
00:11:17,480 --> 00:11:14,490
that was a bus that just said

358
00:11:18,769 --> 00:11:17,490
sponges and no fluid flow so in fact

359
00:11:20,449 --> 00:11:18,779
what we've actually found is something

360
00:11:21,920 --> 00:11:20,459
that's sitting much more like these

361
00:11:24,260 --> 00:11:21,930
systems down on volcanic ridges in the

362
00:11:26,060 --> 00:11:24,270
middle of the Arctic Rift Valley so now

363
00:11:28,519 --> 00:11:26,070

we have a deeper sorting hosted system

364

00:11:30,920 --> 00:11:28,529

that's basically generating another kind

365

00:11:32,870 --> 00:11:30,930

of fluid flow which is also interesting

366

00:11:35,420 --> 00:11:32,880

so I think that's really where I want to

367

00:11:36,800 --> 00:11:35,430

end is my take-home message is when

368

00:11:38,240 --> 00:11:36,810

you're thinking about where might be

369

00:11:40,699 --> 00:11:38,250

interesting in the elsewhere in the

370

00:11:42,560 --> 00:11:40,709

solar system try not to get too

371

00:11:44,030 --> 00:11:42,570

prejudiced by the most recent discovery

372

00:11:45,949 --> 00:11:44,040

somebody showed you recently from the

373

00:11:47,960 --> 00:11:45,959

earth seafloor because every time I go

374

00:11:51,019 --> 00:11:47,970

out and find new things I find even more

375

00:11:52,699 --> 00:11:51,029

new cool interesting things that were

376

00:11:54,829 --> 00:11:52,709

not the things I was looking for but I

377

00:11:55,970 --> 00:11:54,839

stumble upon and I'm you know at least

378

00:11:56,780 --> 00:11:55,980

I'm smart enough where I hang out with

379

00:11:58,639 --> 00:11:56,790

you guys did enough to actually

380

00:12:01,220 --> 00:11:58,649

recognize when they're interesting but

381

00:12:02,449 --> 00:12:01,230

but the idea that we've explored all the

382

00:12:04,610 --> 00:12:02,459

geologic diversity there is on our

383

00:12:06,110 --> 00:12:04,620

planet you know basically the an

384

00:12:08,269 --> 00:12:06,120

exploration is not the way to do it but

385

00:12:10,250 --> 00:12:08,279

the thoughtfulness that would can arise

386

00:12:12,590 --> 00:12:10,260

can be stimulated by this is probably

387

00:12:13,970 --> 00:12:12,600

the way to go is is let's anticipate

388

00:12:15,820 --> 00:12:13,980

there's the same kind of geologic

389

00:12:19,250 --> 00:12:15,830

diversity elsewhere in the solar system