Ask An Astrobiologist

Episode 45: November 19th, 2021

Dr. Geoff Wheat

NASA Astrobiology Program

1
00:00:30,550 --> 00:00:08,950
[Music]

2
00:00:36,310 --> 00:00:33,430
greetings friends fellow earthlings and

3
00:00:38,950 --> 00:00:36,320
maybe explorers of the deep and welcome

4
00:00:40,869 --> 00:00:38,960
to ask an astrobiologist the show that

5
00:00:43,670 --> 00:00:40,879
celebrates the science and celebrates

6
00:00:45,430 --> 00:00:43,680
the scientists involved in our quest to

7
00:00:46,549 --> 00:00:45,440
understand the nature of life the

8
00:00:49,069 --> 00:00:46,559
universe

9
00:00:51,590 --> 00:00:49,079
i'm your host dr graham the

10
00:00:54,430 --> 00:00:51,600
cosmobiologist lao and we're brought to

11
00:00:56,150 --> 00:00:54,440
you by the nasa astrobiology program and

12
00:00:58,389 --> 00:00:56,160
saginet.org

13
00:01:01,670 --> 00:00:58,399

today's episode is going to take us on a

14
00:01:03,510 --> 00:01:01,680
deep oceanic dive with a researcher who

15
00:01:05,910 --> 00:01:03,520
has had more time at sea and in

16
00:01:08,070 --> 00:01:05,920
submersibles than anyone i've ever

17
00:01:09,910 --> 00:01:08,080
personally met uh that's right we're

18
00:01:12,870 --> 00:01:09,920
going to be diving down into the

19
00:01:15,030 --> 00:01:12,880
majestic deep of the ocean to talk about

20
00:01:17,510 --> 00:01:15,040
some current research in the realm of

21
00:01:19,830 --> 00:01:17,520
hydrothermal vents and mud volcanoes and

22
00:01:21,270 --> 00:01:19,840
other interactions of ocean water with

23
00:01:23,270 --> 00:01:21,280
the sea floor

24
00:01:24,149 --> 00:01:23,280
and how that relates to astrobiology as

25
00:01:26,390 --> 00:01:24,159
well

26
00:01:27,590 --> 00:01:26,400
but first as always we like to give a

27
00:01:29,270 --> 00:01:27,600
shout out to

28
00:01:31,190 --> 00:01:29,280
all of you out there who've been

29
00:01:33,670 --> 00:01:31,200
watching our show and supporting us over

30
00:01:36,950 --> 00:01:33,680
the years now uh this is our 45th

31
00:01:39,350 --> 00:01:36,960
episode it's so exciting um a special

32
00:01:40,350 --> 00:01:39,360
thanks goes to denise

33
00:01:41,910 --> 00:01:40,360
at

34
00:01:45,030 --> 00:01:41,920
astrobiodnz

35
00:01:47,510 --> 00:01:45,040
on twitter uh denise has been fantastic

36
00:01:50,230 --> 00:01:47,520
and has been the ambassador of our show

37
00:01:52,310 --> 00:01:50,240
for the past several episodes uh and has

38
00:01:53,590 --> 00:01:52,320

been great at sharing information about

39
00:01:56,630 --> 00:01:53,600
our guests and things that we're doing

40
00:01:58,789 --> 00:01:56,640
but we do appreciate all that you do all

41
00:02:01,109 --> 00:01:58,799
of you in sharing the show and staying

42
00:02:03,590 --> 00:02:01,119
curious and asking questions

43
00:02:04,870 --> 00:02:03,600
now our guest for this show today is dr

44
00:02:07,510 --> 00:02:04,880
jeff wheat

45
00:02:09,749 --> 00:02:07,520
dr wheat is an expert in the realm of

46
00:02:11,190 --> 00:02:09,759
oceanography and the geochemistry of the

47
00:02:13,270 --> 00:02:11,200
ocean floor

48
00:02:14,790 --> 00:02:13,280
he earned an undergraduate degree in

49
00:02:17,510 --> 00:02:14,800
mathematics from the university of new

50
00:02:19,990 --> 00:02:17,520
hampshire before going on to earn his

51
00:02:21,910 --> 00:02:20,000
master's degree and doctoral degree in

52
00:02:23,110 --> 00:02:21,920
oceanography from the university of

53
00:02:25,510 --> 00:02:23,120
washington

54
00:02:27,510 --> 00:02:25,520
he's since had numerous appointments in

55
00:02:29,110 --> 00:02:27,520
various research institutions and is

56
00:02:31,270 --> 00:02:29,120
currently a research professor at the

57
00:02:33,350 --> 00:02:31,280
university of fairbanks uh university of

58
00:02:34,550 --> 00:02:33,360
alaska in fairbanks and is a research

59
00:02:36,470 --> 00:02:34,560
affiliate through the moss landing

60
00:02:39,430 --> 00:02:36,480
marine laboratories

61
00:02:41,750 --> 00:02:39,440
dr wheat's research focuses on processes

62
00:02:44,390 --> 00:02:41,760
that influence the cycles of elements in

63
00:02:46,630 --> 00:02:44,400

the oceans specifically looking at how

64
00:02:48,390 --> 00:02:46,640
fluids transport materials through the

65
00:02:50,790 --> 00:02:48,400
oceanic crust

66
00:02:52,390 --> 00:02:50,800
and back into the sea water uh in places

67
00:02:55,830 --> 00:02:52,400
like hydrothermal vents and mud

68
00:02:59,350 --> 00:02:55,840
volcanoes seeps and more dr wheat has

69
00:03:01,190 --> 00:02:59,360
participated in 79 ocean expeditions of

70
00:03:04,070 --> 00:03:01,200
which 49 of those have included a

71
00:03:06,470 --> 00:03:04,080
submersible or an rov component and he

72
00:03:08,070 --> 00:03:06,480
intends to do more and so please help me

73
00:03:10,710 --> 00:03:08,080
in welcoming and saying thank you for

74
00:03:11,990 --> 00:03:10,720
joining us to dr jeff wheat uh dr wheat

75
00:03:13,670 --> 00:03:12,000
thank you for joining us for ask an

76
00:03:15,270 --> 00:03:13,680
astro biologist

77
00:03:16,470 --> 00:03:15,280
well thank you for thank you for having

78
00:03:17,750 --> 00:03:16,480
me

79
00:03:20,070 --> 00:03:17,760
yeah it's such a pleasure to have you on

80
00:03:22,070 --> 00:03:20,080
the show uh like i said you've been on

81
00:03:24,309 --> 00:03:22,080
far more expeditions in the ocean than

82
00:03:26,229 --> 00:03:24,319
anyone i've ever personally met which i

83
00:03:27,910 --> 00:03:26,239
think is really cool and i'd love to

84
00:03:30,070 --> 00:03:27,920
talk a lot about your current uh

85
00:03:32,550 --> 00:03:30,080
research upcoming research and exploring

86
00:03:34,630 --> 00:03:32,560
the ocean floor but first i'd love to

87
00:03:37,270 --> 00:03:34,640
hear for our audience what your career

88
00:03:39,030 --> 00:03:37,280

path has been um specifically what kind

89
00:03:40,550 --> 00:03:39,040
of drove you into this realm of wanting

90
00:03:43,110 --> 00:03:40,560
to get into the chemical oceanography

91
00:03:45,110 --> 00:03:43,120
and geology of the seafloor

92
00:03:47,270 --> 00:03:45,120
well like i think like most people it

93
00:03:49,830 --> 00:03:47,280
was a circuitous path

94
00:03:51,110 --> 00:03:49,840
it all started out um

95
00:03:52,789 --> 00:03:51,120
visiting and hanging out with my

96
00:03:54,470 --> 00:03:52,799
grandfather when i was a kid and

97
00:03:55,670 --> 00:03:54,480
spending time on the ocean and in the

98
00:03:57,350 --> 00:03:55,680
ocean and

99
00:04:00,710 --> 00:03:57,360
swimming everything from fishing

100
00:04:02,630 --> 00:04:00,720
swimming to boating and so on and then i

101
00:04:04,149 --> 00:04:02,640
went to the university of new hampshire

102
00:04:06,149 --> 00:04:04,159
because they had a

103
00:04:07,670 --> 00:04:06,159
undergraduate minor in oceanography and

104
00:04:09,750 --> 00:04:07,680
i knew i wanted to do something in

105
00:04:12,229 --> 00:04:09,760
oceanography i just didn't know what

106
00:04:14,470 --> 00:04:12,239
i started off in geology

107
00:04:17,189 --> 00:04:14,480
and after my first year i decided when

108
00:04:18,629 --> 00:04:17,199
it came time to take um petrology and

109
00:04:20,390 --> 00:04:18,639
mineralogy that

110
00:04:22,790 --> 00:04:20,400
that didn't look like uh

111
00:04:25,430 --> 00:04:22,800
of my you know that wasn't for me

112
00:04:28,150 --> 00:04:25,440
so instead i switched over to math

113
00:04:30,390 --> 00:04:28,160

and uh continued to work for an

114
00:04:32,230 --> 00:04:30,400
oceanographer on campus a chemical

115
00:04:33,350 --> 00:04:32,240
oceanographer he was dealing with uh

116
00:04:36,070 --> 00:04:33,360
nutrients

117
00:04:38,150 --> 00:04:36,080
in some of the local estuaries and and

118
00:04:39,909 --> 00:04:38,160
rivers

119
00:04:41,189 --> 00:04:39,919
so i wonder if you can tell us what what

120
00:04:42,550 --> 00:04:41,199
is the importance of studying those

121
00:04:44,790 --> 00:04:42,560
kinds of things

122
00:04:46,629 --> 00:04:44,800
of studying estuaries rivers nutrients

123
00:04:47,990 --> 00:04:46,639
cycling in the ocean

124
00:04:49,670 --> 00:04:48,000
um

125
00:04:50,550 --> 00:04:49,680
exactly that

126
00:04:52,710 --> 00:04:50,560
the

127
00:04:55,030 --> 00:04:52,720
rivers are a great source of solutes to

128
00:04:58,070 --> 00:04:55,040
the ocean it's one of the major aspects

129
00:05:00,469 --> 00:04:58,080
of uh tracing elements in the ocean and

130
00:05:02,870 --> 00:05:00,479
the cycle of elements so

131
00:05:04,629 --> 00:05:02,880
and a lot happens in estuaries you might

132
00:05:07,590 --> 00:05:04,639
have a lot of metals coming in

133
00:05:10,390 --> 00:05:07,600
getting deposited in that estuaries um

134
00:05:12,390 --> 00:05:10,400
some estuaries produce metals and it's

135
00:05:13,590 --> 00:05:12,400
all just part of the cycle of

136
00:05:15,670 --> 00:05:13,600
understanding

137
00:05:19,350 --> 00:05:15,680
what goes into the ocean and

138
00:05:20,710 --> 00:05:19,360

um what goes on in the ocean

139
00:05:22,150 --> 00:05:20,720
that's very cool

140
00:05:23,430 --> 00:05:22,160
um and so that kind of like led you then

141
00:05:25,590 --> 00:05:23,440
into your current research which you've

142
00:05:26,950 --> 00:05:25,600
been doing for some time now is studying

143
00:05:29,350 --> 00:05:26,960
you know this cycling of nutrients

144
00:05:31,110 --> 00:05:29,360
cycling of elements through the oceans

145
00:05:33,749 --> 00:05:31,120
um and then you know you've been down

146
00:05:35,189 --> 00:05:33,759
now and a bunch of submersibles um i

147
00:05:37,990 --> 00:05:35,199
wonder for our audience if you can

148
00:05:39,670 --> 00:05:38,000
explain what that process is of going

149
00:05:42,070 --> 00:05:39,680
down in a submersible to explore a

150
00:05:44,070 --> 00:05:42,080
process in the ocean itself as a human

151
00:05:45,670 --> 00:05:44,080
um and maybe even what it was like your

152
00:05:47,270 --> 00:05:45,680
first time going down in something like

153
00:05:48,790 --> 00:05:47,280
alvin

154
00:05:50,310 --> 00:05:48,800
yeah um i've been down in several

155
00:05:52,790 --> 00:05:50,320
different subs but they're pretty much

156
00:05:54,950 --> 00:05:52,800
all the same in the sense of uh there's

157
00:05:57,189 --> 00:05:54,960
a defined time where you expected to be

158
00:05:58,390 --> 00:05:57,199
on deck and when they expected the sub

159
00:06:01,510 --> 00:05:58,400
to come up it's usually eight in the

160
00:06:03,029 --> 00:06:01,520
morning till five at night

161
00:06:05,189 --> 00:06:03,039
and you get in the sub

162
00:06:06,950 --> 00:06:05,199
they launch you which is usually pretty

163
00:06:09,110 --> 00:06:06,960

quick because they want to get you away

164
00:06:10,629 --> 00:06:09,120
from the ship as quickly as possible

165
00:06:12,870 --> 00:06:10,639
and then it takes a couple hours to go

166
00:06:14,629 --> 00:06:12,880
down and on the way down there's a lot

167
00:06:18,550 --> 00:06:14,639
of bioluminescence

168
00:06:20,790 --> 00:06:18,560
as the sub sinks through um the water

169
00:06:22,629 --> 00:06:20,800
it disturbs the the local critters and

170
00:06:24,469 --> 00:06:22,639
they just buy a luminess and it's quite

171
00:06:26,150 --> 00:06:24,479
a show sometimes

172
00:06:28,390 --> 00:06:26,160
and then once you're down at the bottom

173
00:06:30,230 --> 00:06:28,400
you probably have four or five hours on

174
00:06:32,150 --> 00:06:30,240
the bottom to do your work

175
00:06:33,749 --> 00:06:32,160
and it's quite cold because there's no

176
00:06:36,550 --> 00:06:33,759
heaters and it's

177
00:06:39,110 --> 00:06:36,560
the titanium sphere cools quickly

178
00:06:41,590 --> 00:06:39,120
um and then it's back up another two

179
00:06:43,670 --> 00:06:41,600
hours back to the surface where you bob

180
00:06:45,350 --> 00:06:43,680
around on the ocean until they get the

181
00:06:47,990 --> 00:06:45,360
ship near you and can pick you up and

182
00:06:49,189 --> 00:06:48,000
put you on the on the fan tail of the

183
00:06:51,189 --> 00:06:49,199
ship

184
00:06:52,550 --> 00:06:51,199
but it's uh it's quite something the

185
00:06:54,950 --> 00:06:52,560
first time you're down there you're

186
00:06:57,189 --> 00:06:54,960
you're just looking in awe of

187
00:06:59,029 --> 00:06:57,199
that you're actually at the seafloor and

188
00:07:00,469 --> 00:06:59,039

all the cool critters that you've never

189
00:07:01,589 --> 00:07:00,479
seen before

190
00:07:03,350 --> 00:07:01,599
um

191
00:07:05,029 --> 00:07:03,360
and it's uh

192
00:07:07,350 --> 00:07:05,039
it's certainly uh an eye-opening

193
00:07:09,110 --> 00:07:07,360
experience

194
00:07:10,390 --> 00:07:09,120
it sounds like almost similar to space

195
00:07:12,870 --> 00:07:10,400
exploration as well you know you're

196
00:07:14,469 --> 00:07:12,880
going into this very remote exotic

197
00:07:16,469 --> 00:07:14,479
environment where humans don't belong

198
00:07:18,230 --> 00:07:16,479
and it requires something like a

199
00:07:20,070 --> 00:07:18,240
spacesuit or a submersible or a

200
00:07:21,670 --> 00:07:20,080
spaceship to protect us

201
00:07:22,790 --> 00:07:21,680
from that environment i'm glad you

202
00:07:24,950 --> 00:07:22,800
mentioned you know it's four or five

203
00:07:26,469 --> 00:07:24,960
hours in the bottom um one thing i

204
00:07:27,909 --> 00:07:26,479
wondered and maybe our audience does too

205
00:07:28,870 --> 00:07:27,919
you know like they always ask astronauts

206
00:07:31,029 --> 00:07:28,880
like how do you go to the bathroom in

207
00:07:32,309 --> 00:07:31,039
space but i think four or five hours is

208
00:07:33,510 --> 00:07:32,319
probably long and they're probably short

209
00:07:36,070 --> 00:07:33,520
enough it doesn't actually matter that

210
00:07:39,749 --> 00:07:36,080
much when you're down the submersible

211
00:07:41,029 --> 00:07:39,759
um i do recall from the film on a sphere

212
00:07:42,390 --> 00:07:41,039
which is based on a book by michael

213
00:07:43,909 --> 00:07:42,400

creighton there's a scene where they're

214
00:07:46,710 --> 00:07:43,919
descending in a submersible through the

215
00:07:49,189 --> 00:07:46,720
water and the the psychologist on board

216
00:07:51,510 --> 00:07:49,199
hears the creaking of the hall of the

217
00:07:53,350 --> 00:07:51,520
submersible and becomes terrified um

218
00:07:54,869 --> 00:07:53,360
does that happen in real life what's it

219
00:07:56,629 --> 00:07:54,879
like is there any experience that kind

220
00:07:58,390 --> 00:07:56,639
of scares you a little bit

221
00:08:00,550 --> 00:07:58,400
um there's no creaking

222
00:08:01,990 --> 00:08:00,560
uh in most part because the pilot has

223
00:08:02,790 --> 00:08:02,000
music playing

224
00:08:10,150 --> 00:08:02,800
uh

225
00:08:12,550 --> 00:08:10,160
hard rock and so you usually don't hear

226
00:08:14,230 --> 00:08:12,560
anything like that um there is always

227
00:08:15,990 --> 00:08:14,240
some condensation after you're done on

228
00:08:17,510 --> 00:08:16,000
the sea floor for a while

229
00:08:20,390 --> 00:08:17,520
um as the

230
00:08:22,790 --> 00:08:20,400
sphere cools and as you keep breathing

231
00:08:25,029 --> 00:08:22,800
and uh so that always adds a nice little

232
00:08:26,629 --> 00:08:25,039
mixture of fun with it with the new

233
00:08:28,230 --> 00:08:26,639
people um

234
00:08:32,070 --> 00:08:28,240
you know suggesting that potentially the

235
00:08:36,310 --> 00:08:33,590
that's gotta be a little terrifying

236
00:08:38,149 --> 00:08:36,320
[Laughter]

237
00:08:40,709 --> 00:08:38,159
so uh god

238
00:08:43,190 --> 00:08:40,719

yeah no but mostly they're so in awe of

239
00:08:45,430 --> 00:08:43,200
what's going on outside um and that

240
00:08:47,829 --> 00:08:45,440
they're down there that um

241
00:08:49,910 --> 00:08:47,839
yeah it's it's a lot a lot of things are

242
00:08:51,190 --> 00:08:49,920
lost on the new people which makes me

243
00:08:53,350 --> 00:08:51,200
wonder is that the same way with an

244
00:08:55,509 --> 00:08:53,360
astronaut you know the the first time or

245
00:08:56,710 --> 00:08:55,519
they they're up is their first day kind

246
00:09:00,070 --> 00:08:56,720
of

247
00:09:01,269 --> 00:09:00,080
the technology and the beauty and

248
00:09:04,070 --> 00:09:01,279
everything else

249
00:09:06,389 --> 00:09:04,080
uh before they can get settled in

250
00:09:07,670 --> 00:09:06,399
um okay

251
00:09:09,269 --> 00:09:07,680
it's a very good question and it would

252
00:09:10,070 --> 00:09:09,279
be worth asking an astronaut what that's

253
00:09:11,910 --> 00:09:10,080
like

254
00:09:13,509 --> 00:09:11,920
um i know so that now now we do longer

255
00:09:15,350 --> 00:09:13,519
stays in the international space station

256
00:09:16,870 --> 00:09:15,360
but it used to be that a lot of the food

257
00:09:19,430 --> 00:09:16,880
that was sent to space with astronauts

258
00:09:20,630 --> 00:09:19,440
especially for shorter trips was was

259
00:09:22,230 --> 00:09:20,640
spicier

260
00:09:23,590 --> 00:09:22,240
more flavorful than usual because when

261
00:09:25,350 --> 00:09:23,600
they go to space for the first time

262
00:09:27,030 --> 00:09:25,360
their all of their their mucus and their

263
00:09:28,230 --> 00:09:27,040

sinuses kind of rises up everywhere

264
00:09:29,990 --> 00:09:28,240
because there's no gravity pulling it

265
00:09:31,590 --> 00:09:30,000
down and so it actually interferes with

266
00:09:33,670 --> 00:09:31,600
their sense of smell a little bit and so

267
00:09:34,710 --> 00:09:33,680
tasting things and smelling things is a

268
00:09:37,110 --> 00:09:34,720
little different in space for the

269
00:09:39,350 --> 00:09:37,120
astronauts which must also be kind of a

270
00:09:41,190 --> 00:09:39,360
unique experience to kind of have that

271
00:09:43,269 --> 00:09:41,200
for the first time plus just the all of

272
00:09:44,870 --> 00:09:43,279
looking at the earth from space or in

273
00:09:46,790 --> 00:09:44,880
your case the all of seeing something

274
00:09:48,470 --> 00:09:46,800
like bioluminescence that far down in

275
00:09:50,070 --> 00:09:48,480
the ocean is you're disturbing things

276
00:09:52,550 --> 00:09:50,080
like dinoflagellates and other creatures

277
00:09:53,910 --> 00:09:52,560
going down

278
00:09:55,910 --> 00:09:53,920
yes yeah

279
00:09:57,750 --> 00:09:55,920
and there and being on the sea floor

280
00:09:59,350 --> 00:09:57,760
there's there's new critters everywhere

281
00:10:00,710 --> 00:09:59,360
um

282
00:10:03,990 --> 00:10:00,720
you know if you wanted to find a new

283
00:10:05,350 --> 00:10:04,000
species it wouldn't be very difficult

284
00:10:07,030 --> 00:10:05,360
i imagine that's a great way to get a

285
00:10:08,470 --> 00:10:07,040
bunch of papers published is just to be

286
00:10:09,910 --> 00:10:08,480
on the sea floor and just discover a

287
00:10:11,509 --> 00:10:09,920
whole bunch of new species and things

288
00:10:12,949 --> 00:10:11,519

like that

289
00:10:15,910 --> 00:10:12,959
and in that vein of exploring the

290
00:10:19,509 --> 00:10:15,920
seafloor through the nasa astrobio

291
00:10:21,910 --> 00:10:19,519
twitter account we asked our audience

292
00:10:24,069 --> 00:10:21,920
when the first year is that humans went

293
00:10:25,990 --> 00:10:24,079
down in a submersible and discovered

294
00:10:29,509 --> 00:10:26,000
hydrothermal vents

295
00:10:32,790 --> 00:10:29,519
we had a few options of 1960 1965

296
00:10:35,590 --> 00:10:32,800
1971 and 1977

297
00:10:37,910 --> 00:10:35,600
most people said 1971

298
00:10:40,069 --> 00:10:37,920
but it was actually 1977

299
00:10:41,670 --> 00:10:40,079
um so there many years before that there

300
00:10:43,910 --> 00:10:41,680
were people who were hypothesizing there

301
00:10:45,430 --> 00:10:43,920
were these systems on the sea floor

302
00:10:47,430 --> 00:10:45,440
where it appeared there was some heat

303
00:10:49,190 --> 00:10:47,440
coming out um there were some you know

304
00:10:50,949 --> 00:10:49,200
potential ideas of this idea that there

305
00:10:52,949 --> 00:10:50,959
could be something down there but it was

306
00:10:54,790 --> 00:10:52,959
77 when the first paper came out and the

307
00:10:56,310 --> 00:10:54,800
first people went down and observed

308
00:10:59,030 --> 00:10:56,320
hydrothermal vents that's the same year

309
00:11:00,389 --> 00:10:59,040
that voyager 1 launched to space

310
00:11:01,990 --> 00:11:00,399
for our audience

311
00:11:04,230 --> 00:11:02,000
so dr wheat i'm wondering if you could

312
00:11:07,190 --> 00:11:04,240
kind of give us your vision of what what

313
00:11:09,110 --> 00:11:07,200

hydrothermal vents are on the sea floor

314
00:11:10,949 --> 00:11:09,120
um and maybe even help us connect those

315
00:11:13,829 --> 00:11:10,959
to other worlds

316
00:11:16,949 --> 00:11:13,839
so so they vary uh drastically depending

317
00:11:19,190 --> 00:11:16,959
on the geologic setting as well as how

318
00:11:20,790 --> 00:11:19,200
hot the fluids are that are coming out

319
00:11:23,430 --> 00:11:20,800
so like the ones that you were talking

320
00:11:25,030 --> 00:11:23,440
about at the galapagos uh those by the

321
00:11:27,829 --> 00:11:25,040
time there were high temperature waters

322
00:11:30,470 --> 00:11:27,839
at depth but they mixed and cooled

323
00:11:33,030 --> 00:11:30,480
before conductively before they came out

324
00:11:35,269 --> 00:11:33,040
at the sea floor and so they were lower

325
00:11:36,790 --> 00:11:35,279
temperature coming out but they were

326
00:11:37,829 --> 00:11:36,800
carried reduced

327
00:11:39,829 --> 00:11:37,839
elements

328
00:11:41,350 --> 00:11:39,839
and supported life

329
00:11:43,990 --> 00:11:41,360
tube worms and

330
00:11:44,870 --> 00:11:44,000
microbial mats and so on and and and

331
00:11:46,790 --> 00:11:44,880
then

332
00:11:47,829 --> 00:11:46,800
other animals would come by and eat

333
00:11:48,790 --> 00:11:47,839
those guys

334
00:11:50,150 --> 00:11:48,800
um

335
00:11:51,509 --> 00:11:50,160
then there's the uh more the high

336
00:11:53,030 --> 00:11:51,519
temperature ones where the high

337
00:11:55,430 --> 00:11:53,040
temperature fluids are exiting at the

338
00:11:57,110 --> 00:11:55,440

seafloor those are typically metal rich

339
00:11:58,310 --> 00:11:57,120
and form the nice big sulfide ore

340
00:12:00,389 --> 00:11:58,320
deposits

341
00:12:01,829 --> 00:12:00,399
um that are on the seafloor

342
00:12:05,590 --> 00:12:01,839
and

343
00:12:08,949 --> 00:12:05,600
those are quite spectacular those can be

344
00:12:11,350 --> 00:12:08,959
10 20 meters high you know meters in

345
00:12:12,310 --> 00:12:11,360
diameter and just absolutely beautiful

346
00:12:14,550 --> 00:12:12,320
um

347
00:12:15,829 --> 00:12:14,560
and intricate with water coming out in

348
00:12:18,069 --> 00:12:15,839
different areas

349
00:12:20,870 --> 00:12:18,079
um and uh

350
00:12:24,069 --> 00:12:20,880
everything from worms to crabs to a

351
00:12:25,910 --> 00:12:24,079
whole ecosystem on the seafloor

352
00:12:28,710 --> 00:12:25,920
and then there's also other places where

353
00:12:31,670 --> 00:12:28,720
water comes out much slower let's say

354
00:12:34,230 --> 00:12:31,680
uh through mud volcanism and those can

355
00:12:37,910 --> 00:12:34,240
be everything from uh subduction zones

356
00:12:39,030 --> 00:12:37,920
that could be mostly from the deep earth

357
00:12:41,590 --> 00:12:39,040
and could be

358
00:12:44,870 --> 00:12:41,600
uh mostly methane related fluids or they

359
00:12:47,030 --> 00:12:44,880
could be from serpentine formation and

360
00:12:50,629 --> 00:12:47,040
uh hydrogen and methane rich

361
00:12:51,829 --> 00:12:50,639
so it's quite quite a variety

362
00:12:53,190 --> 00:12:51,839
yeah there's seems there's so many

363
00:12:55,030 --> 00:12:53,200

different places in the sea floor to

364
00:12:56,150 --> 00:12:55,040
study some of these really intriguing

365
00:12:57,590 --> 00:12:56,160
processes and there are lots of

366
00:12:59,590 --> 00:12:57,600
different processes

367
00:13:01,990 --> 00:12:59,600
um and for me as an astrobiologist to

368
00:13:05,509 --> 00:13:02,000
connect that then to like enceladus you

369
00:13:07,509 --> 00:13:05,519
know with nasa's cassini we observed

370
00:13:09,670 --> 00:13:07,519
with enceladus plumes of fluid coming

371
00:13:11,430 --> 00:13:09,680
out and we measured some of those plumes

372
00:13:13,829 --> 00:13:11,440
and had detections that could suggest

373
00:13:15,590 --> 00:13:13,839
the the likelihood of hydrothermal vents

374
00:13:16,870 --> 00:13:15,600
uh in that ocean

375
00:13:18,230 --> 00:13:16,880
i wonder like someone who studied

376
00:13:20,310 --> 00:13:18,240
hydrothermal vents and studied mud

377
00:13:22,790 --> 00:13:20,320
volcanoes in these processes do you

378
00:13:24,629 --> 00:13:22,800
think it's likely that many of the ocean

379
00:13:28,310 --> 00:13:24,639
worlds in our solar system and maybe

380
00:13:30,069 --> 00:13:28,320
even in the galaxy um are are you know

381
00:13:31,750 --> 00:13:30,079
have plentiful hydrothermal vent systems

382
00:13:33,269 --> 00:13:31,760
and plenty of these potential ecosystems

383
00:13:34,949 --> 00:13:33,279
as well

384
00:13:36,710 --> 00:13:34,959
uh it's entirely likely as long as

385
00:13:37,829 --> 00:13:36,720
there's some sort of techno tectonic

386
00:13:39,590 --> 00:13:37,839
forces

387
00:13:42,150 --> 00:13:39,600
uh in play

388
00:13:43,910 --> 00:13:42,160

um some of the other things uh that are

389
00:13:45,590 --> 00:13:43,920
of interest that i spend a lot of my

390
00:13:46,389 --> 00:13:45,600
effort on is some of the ridge plank

391
00:13:49,030 --> 00:13:46,399
work

392
00:13:51,750 --> 00:13:49,040
where there's uh no where where

393
00:13:54,310 --> 00:13:51,760
basically the fluid flow is driven by

394
00:13:56,629 --> 00:13:54,320
differences in conduction um and

395
00:13:57,910 --> 00:13:56,639
differences in basement topography and

396
00:13:58,870 --> 00:13:57,920
sedimentation

397
00:14:01,430 --> 00:13:58,880
so they're

398
00:14:04,310 --> 00:14:01,440
um typically lower temperature

399
00:14:07,350 --> 00:14:04,320
15 to 60 degrees celsius

400
00:14:09,350 --> 00:14:07,360
and uh less altered not so much the

401
00:14:11,829 --> 00:14:09,360
metal carrying fluids like a high

402
00:14:13,189 --> 00:14:11,839
temperature hydrothermal system

403
00:14:15,829 --> 00:14:13,199
but you don't really

404
00:14:17,670 --> 00:14:15,839
need that mantle source right there like

405
00:14:19,829 --> 00:14:17,680
a high temperature hydrothermal system

406
00:14:21,509 --> 00:14:19,839
needs a mental source of heat

407
00:14:23,750 --> 00:14:21,519
um or

408
00:14:25,030 --> 00:14:23,760
in subduction zones you need tectonic

409
00:14:27,269 --> 00:14:25,040
plates moving

410
00:14:28,949 --> 00:14:27,279
uh in one direction or another

411
00:14:31,910 --> 00:14:28,959
so so

412
00:14:33,590 --> 00:14:31,920
yeah there's a whole variety of uh means

413
00:14:35,750 --> 00:14:33,600

for fluid to flow through

414
00:14:36,710 --> 00:14:35,760
an ocean crust and to then

415
00:14:38,069 --> 00:14:36,720
uh

416
00:14:40,230 --> 00:14:38,079
advance some of these water rock

417
00:14:42,389 --> 00:14:40,240
reactions within the crust

418
00:14:44,629 --> 00:14:42,399
um so it just depends on on the

419
00:14:45,590 --> 00:14:44,639
particular planet or

420
00:14:48,949 --> 00:14:45,600
uh

421
00:14:50,150 --> 00:14:48,959
you know body that you're looking at

422
00:14:51,590 --> 00:14:50,160
it's very intriguing and you also

423
00:14:53,750 --> 00:14:51,600
mentioned you know with mud volcanoes

424
00:14:56,069 --> 00:14:53,760
and some of these serpentinizing systems

425
00:14:58,310 --> 00:14:56,079
um for our audience tibetanization is

426
00:15:00,310 --> 00:14:58,320
this process where certain minerals will

427
00:15:01,990 --> 00:15:00,320
interact with water and form things like

428
00:15:03,509 --> 00:15:02,000
hydrogen gas

429
00:15:05,670 --> 00:15:03,519
and there are creatures here on earth

430
00:15:07,509 --> 00:15:05,680
who can use that hydrogen gas and

431
00:15:08,710 --> 00:15:07,519
something like carbon dioxide and make

432
00:15:10,629 --> 00:15:08,720
methane

433
00:15:12,629 --> 00:15:10,639
as an energy source as a metabolism and

434
00:15:15,189 --> 00:15:12,639
so it's really intriguing as a place for

435
00:15:17,670 --> 00:15:15,199
us to kind of hunt um for potential

436
00:15:19,269 --> 00:15:17,680
signs of biological activity there might

437
00:15:22,550 --> 00:15:19,279
even be serpentinizing systems from the

438
00:15:24,230 --> 00:15:22,560

past on mars um for us to explore so i'm

439
00:15:25,670 --> 00:15:24,240
very glad you made that connection and

440
00:15:27,189 --> 00:15:25,680
we talked before the show a little bit

441
00:15:29,189 --> 00:15:27,199
about some of your upcoming research on

442
00:15:31,590 --> 00:15:29,199
mud volcanoes um and you mentioned

443
00:15:33,110 --> 00:15:31,600
something to me called blue mud um i'm

444
00:15:35,030 --> 00:15:33,120
wondering if you could go a little bit

445
00:15:36,470 --> 00:15:35,040
into explaining what that is and why

446
00:15:38,230 --> 00:15:36,480
that's an intriguing thing for us to

447
00:15:39,030 --> 00:15:38,240
study on the sea floor

448
00:15:41,110 --> 00:15:39,040
yeah

449
00:15:43,670 --> 00:15:41,120
serpentinization and mud volcanoes from

450
00:15:46,550 --> 00:15:43,680
it have uh existed on earth

451
00:15:48,069 --> 00:15:46,560
for uh up to maybe billions of years and

452
00:15:50,949 --> 00:15:48,079
and where it's happening right now is at

453
00:15:53,269 --> 00:15:50,959
the mariana forearc where the mariana

454
00:15:56,150 --> 00:15:53,279
trench is dipping down underneath the

455
00:15:58,629 --> 00:15:56,160
philippine trench and as that

456
00:16:00,790 --> 00:15:58,639
as a pacific plate dips underneath the

457
00:16:02,470 --> 00:16:00,800
philippine plate the philippine plate

458
00:16:04,389 --> 00:16:02,480
has some cracks in it

459
00:16:06,310 --> 00:16:04,399
the water from the pacific plate goes up

460
00:16:07,590 --> 00:16:06,320
through those cracks reacts with the

461
00:16:09,269 --> 00:16:07,600
mantle

462
00:16:11,990 --> 00:16:09,279
in the overlying plate

463
00:16:14,949 --> 00:16:12,000

and that reaction causes the water and

464
00:16:17,350 --> 00:16:14,959
the heat with the the mantle rock forms

465
00:16:19,829 --> 00:16:17,360
serpentine minerals and it forms a mud

466
00:16:22,550 --> 00:16:19,839
matrix with serpentinite minerals as

467
00:16:25,990 --> 00:16:22,560
well as water the ph of these fluids can

468
00:16:27,030 --> 00:16:26,000
be anywhere from 10 to 12 and a half

469
00:16:28,870 --> 00:16:27,040
and

470
00:16:31,509 --> 00:16:28,880
they form some of the largest mud

471
00:16:33,990 --> 00:16:31,519
volcanoes on earth up to 50 kilometers

472
00:16:36,870 --> 00:16:34,000
wide and four kilometers high

473
00:16:38,870 --> 00:16:36,880
and the mud itself is blue it's the only

474
00:16:40,870 --> 00:16:38,880
place i've ever gone

475
00:16:41,990 --> 00:16:40,880
um where you find naturally occurring

476
00:16:44,949 --> 00:16:42,000
blue mud

477
00:16:45,910 --> 00:16:44,959
and we don't know exactly why it's blue

478
00:16:48,310 --> 00:16:45,920
um

479
00:16:51,509 --> 00:16:48,320
but when you have it out on the counter

480
00:16:54,710 --> 00:16:51,519
and it's exposed to atmospheric oxygen

481
00:16:56,470 --> 00:16:54,720
um over a period of a couple of days it

482
00:16:58,870 --> 00:16:56,480
turns green sort of what you would

483
00:17:01,910 --> 00:16:58,880
expect from a serpentine diet so it has

484
00:17:03,990 --> 00:17:01,920
something to do with the the way it's

485
00:17:06,549 --> 00:17:04,000
reduced fluids or gases that are

486
00:17:08,069 --> 00:17:06,559
dissolved or part of the matrix that

487
00:17:09,750 --> 00:17:08,079
make it form blue

488
00:17:11,990 --> 00:17:09,760

a blue color but it's

489
00:17:13,590 --> 00:17:12,000
it's quite fascinating and as you

490
00:17:15,829 --> 00:17:13,600
pointed out too there's microbes that

491
00:17:17,110 --> 00:17:15,839
live in that system

492
00:17:19,110 --> 00:17:17,120
and so

493
00:17:20,870 --> 00:17:19,120
as a conveyor belt from the pacific

494
00:17:22,230 --> 00:17:20,880
plate the big question is

495
00:17:24,309 --> 00:17:22,240
do you get some of these microbes that

496
00:17:26,630 --> 00:17:24,319
take the conveyor belt down and then

497
00:17:28,870 --> 00:17:26,640
come back up uh through some of these

498
00:17:32,630 --> 00:17:28,880
mud volcanoes some of them only get up

499
00:17:33,510 --> 00:17:32,640
to 150 degrees celsius some even less

500
00:17:35,270 --> 00:17:33,520
um

501
00:17:38,070 --> 00:17:35,280
probably the ones that come up you know

502
00:17:40,390 --> 00:17:38,080
they reach warmer temperatures like 250

503
00:17:42,470 --> 00:17:40,400
degrees celsius at depth probably

504
00:17:44,470 --> 00:17:42,480
there's no microbes there but

505
00:17:46,950 --> 00:17:44,480
but there's potential for the that whole

506
00:17:49,270 --> 00:17:46,960
cycle and loop and

507
00:17:50,710 --> 00:17:49,280
since these mud volcanoes are

508
00:17:53,669 --> 00:17:50,720
some of them are probably 50 million

509
00:17:56,230 --> 00:17:53,679
years old you have an ample time for

510
00:17:58,070 --> 00:17:56,240
abiotic reactions at these high ph's

511
00:18:01,350 --> 00:17:58,080
high methane

512
00:18:02,870 --> 00:18:01,360
high hydrogen uh fluids to

513
00:18:04,230 --> 00:18:02,880

potentially form

514
00:18:06,390 --> 00:18:04,240
um

515
00:18:08,950 --> 00:18:06,400
simple inorganics and and other

516
00:18:10,630 --> 00:18:08,960
molecules that may be uh quite helpful

517
00:18:12,390 --> 00:18:10,640
for life

518
00:18:13,909 --> 00:18:12,400
yeah and when i mean we really are just

519
00:18:16,310 --> 00:18:13,919
getting to touch the tip of the iceberg

520
00:18:18,230 --> 00:18:16,320
really and what lives in the ocean and

521
00:18:20,470 --> 00:18:18,240
and and what things dwell in the ocean

522
00:18:21,990 --> 00:18:20,480
sediments as well i love that idea of

523
00:18:24,470 --> 00:18:22,000
some organisms potentially going down

524
00:18:26,390 --> 00:18:24,480
the conveyor belt and back up again um

525
00:18:29,590 --> 00:18:26,400
you know the ocean floor it has so much

526
00:18:31,909 --> 00:18:29,600
for us to still explore and to learn uh

527
00:18:34,630 --> 00:18:31,919
we even on twitter through nasa astrobio

528
00:18:37,190 --> 00:18:34,640
we asked our audience um roughly how

529
00:18:39,590 --> 00:18:37,200
much of the seafloor has been explored

530
00:18:41,029 --> 00:18:39,600
um based on current estimates

531
00:18:45,110 --> 00:18:41,039
we had some different answers come in at

532
00:18:47,750 --> 00:18:45,120
10 15 20 and 25 percent uh most people

533
00:18:49,990 --> 00:18:47,760
said 10 some said even less

534
00:18:52,710 --> 00:18:50,000
um but actually right now the number

535
00:18:54,470 --> 00:18:52,720
somewhere around 20 or so of high

536
00:18:56,870 --> 00:18:54,480
resolution mapping has occurred on the

537
00:18:58,470 --> 00:18:56,880
sea floor but then for exploration for

538
00:19:00,549 --> 00:18:58,480

going down and seeing what organisms

539
00:19:03,029 --> 00:19:00,559
there it seems that there's so there's

540
00:19:04,789 --> 00:19:03,039
still so much left for us to explore

541
00:19:06,310 --> 00:19:04,799
on the seafloor i remember when i was an

542
00:19:08,470 --> 00:19:06,320
undergraduate student we had this this

543
00:19:10,789 --> 00:19:08,480
course it was a marine ecology of the

544
00:19:13,029 --> 00:19:10,799
chesapeake bay and it was the first time

545
00:19:15,029 --> 00:19:13,039
i learned about whale fall uh that when

546
00:19:17,190 --> 00:19:15,039
the bodies of citations when they die

547
00:19:18,789 --> 00:19:17,200
their bodies fall to the ocean floor and

548
00:19:20,950 --> 00:19:18,799
they create these environments where

549
00:19:22,710 --> 00:19:20,960
microbes and other things can come in

550
00:19:24,710 --> 00:19:22,720
and dwell not just for you know a few

551
00:19:27,270 --> 00:19:24,720
years as they break down the whale but

552
00:19:29,430 --> 00:19:27,280
for centuries as as the whale's body is

553
00:19:31,830 --> 00:19:29,440
degraded and eaten and kind of adds this

554
00:19:33,270 --> 00:19:31,840
chemical environment uh so dr v i'm

555
00:19:35,990 --> 00:19:33,280
wondering if you can give us kind of

556
00:19:38,150 --> 00:19:36,000
your vision of you know what is the sea

557
00:19:41,029 --> 00:19:38,160
floor to us humans why should we go

558
00:19:42,710 --> 00:19:41,039
explore this yet unexplored environment

559
00:19:44,950 --> 00:19:42,720
in some cases what is it we learn from

560
00:19:46,470 --> 00:19:44,960
these creatures and processes on the

561
00:19:48,710 --> 00:19:46,480
deep sea

562
00:19:50,710 --> 00:19:48,720
yeah well um i would say even though

563
00:19:53,350 --> 00:19:50,720

maybe 20 percent of the sea floor has

564
00:19:56,070 --> 00:19:53,360
been mapped you still have problems with

565
00:19:57,750 --> 00:19:56,080
uh let's say nuclear subs u.s navy subs

566
00:19:58,630 --> 00:19:57,760
running into sea mounts

567
00:20:00,470 --> 00:19:58,640
um

568
00:20:03,190 --> 00:20:00,480
which was just recently another one did

569
00:20:05,830 --> 00:20:03,200
that and uh so i would say

570
00:20:07,430 --> 00:20:05,840
maybe i mean obviously we need to do a

571
00:20:09,669 --> 00:20:07,440
better job and

572
00:20:12,230 --> 00:20:09,679
of more mapping and more coverage

573
00:20:13,990 --> 00:20:12,240
but as for the actual being down there

574
00:20:15,510 --> 00:20:14,000
and seeing things i would say it's way

575
00:20:18,549 --> 00:20:15,520
less than one percent

576
00:20:21,029 --> 00:20:18,559
um and sort of a case in point uh we

577
00:20:22,630 --> 00:20:21,039
were doing some work off costa rica at

578
00:20:25,430 --> 00:20:22,640
dorado outcrop

579
00:20:28,470 --> 00:20:25,440
um and it was a purely geochemical

580
00:20:29,669 --> 00:20:28,480
geophysical uh and some microbiology

581
00:20:32,470 --> 00:20:29,679
format

582
00:20:34,870 --> 00:20:32,480
um and and getting us there and we

583
00:20:37,350 --> 00:20:34,880
discovered all these female octopuses

584
00:20:40,149 --> 00:20:37,360
that were um sitting in the warm

585
00:20:42,070 --> 00:20:40,159
hydrothermal fluids with their egg cases

586
00:20:44,870 --> 00:20:42,080
um and they were

587
00:20:47,510 --> 00:20:44,880
just in those hydrothermal areas where

588
00:20:49,270 --> 00:20:47,520

the water is coming out you know just

589
00:20:51,029 --> 00:20:49,280
you know five meters away

590
00:20:53,270 --> 00:20:51,039
there were no you know where there's no

591
00:20:54,950 --> 00:20:53,280
water coming out there's no octopuses

592
00:20:55,909 --> 00:20:54,960
and there were hundreds of them

593
00:20:58,310 --> 00:20:55,919
and then

594
00:21:00,149 --> 00:20:58,320
um a couple of years ago on davidson

595
00:21:03,669 --> 00:21:00,159
seamount off california

596
00:21:06,149 --> 00:21:03,679
they found thousands of octopuses

597
00:21:07,990 --> 00:21:06,159
similar to these all laying their eggs

598
00:21:10,149 --> 00:21:08,000
all in hydrothermal all in

599
00:21:11,029 --> 00:21:10,159
low-temperature hydrothermal fluids

600
00:21:14,070 --> 00:21:11,039
and

601
00:21:16,630 --> 00:21:14,080
uh you know it's just a a whole set of

602
00:21:18,230 --> 00:21:16,640
ecology that we never learned about and

603
00:21:19,350 --> 00:21:18,240
the only reason why we did was because

604
00:21:21,750 --> 00:21:19,360
we were

605
00:21:22,549 --> 00:21:21,760
down there for another purpose um

606
00:21:24,630 --> 00:21:22,559
so

607
00:21:26,870 --> 00:21:24,640
i i would say there's very little is

608
00:21:28,870 --> 00:21:26,880
known um

609
00:21:31,110 --> 00:21:28,880
about the ecology and then there's the

610
00:21:34,310 --> 00:21:31,120
question about ecosystem services you

611
00:21:36,710 --> 00:21:34,320
know what what are these um areas these

612
00:21:38,630 --> 00:21:36,720
hydrothermal areas doing

613
00:21:40,789 --> 00:21:38,640

like say for the octopuses how important

614
00:21:42,149 --> 00:21:40,799
is that on a global scale or for a

615
00:21:44,230 --> 00:21:42,159
species scale

616
00:21:46,070 --> 00:21:44,240
and then what what are they doing by

617
00:21:47,909 --> 00:21:46,080
distributing carbon by going to these

618
00:21:49,909 --> 00:21:47,919
particular sites and living there and

619
00:21:51,430 --> 00:21:49,919
moving back and forth and so on so i

620
00:21:53,750 --> 00:21:51,440
think there's a lot

621
00:21:55,110 --> 00:21:53,760
that we we just don't know

622
00:21:57,590 --> 00:21:55,120
um

623
00:21:59,750 --> 00:21:57,600
you know going there is a step step you

624
00:22:01,270 --> 00:21:59,760
know the first step

625
00:22:03,029 --> 00:22:01,280
that's incredible yeah and it makes me

626
00:22:04,390 --> 00:22:03,039
want to go explore i've been diving in

627
00:22:05,750 --> 00:22:04,400
the ocean before

628
00:22:07,590 --> 00:22:05,760
but certainly have nowhere near the

629
00:22:09,270 --> 00:22:07,600
experience you have of seeing the ocean

630
00:22:10,630 --> 00:22:09,280
first hand and experiencing the ocean

631
00:22:13,430 --> 00:22:10,640
first hand

632
00:22:15,590 --> 00:22:13,440
i currently live in colorado and we have

633
00:22:18,710 --> 00:22:15,600
no oceans nearby that i can just drive

634
00:22:20,149 --> 00:22:18,720
to and i do miss the feeling um of being

635
00:22:21,590 --> 00:22:20,159
close to the ocean being close to the

636
00:22:23,510 --> 00:22:21,600
sea i think it's been a call for

637
00:22:25,350 --> 00:22:23,520
humanity for a long time

638
00:22:26,630 --> 00:22:25,360

and it's been a call for us to want to

639
00:22:28,549 --> 00:22:26,640
explore

640
00:22:30,789 --> 00:22:28,559
i'm wondering you know what what kind of

641
00:22:33,110 --> 00:22:30,799
advice do you have for potential young

642
00:22:34,710 --> 00:22:33,120
explorers right now who want to get

643
00:22:36,149 --> 00:22:34,720
involved in your line of work and get

644
00:22:37,990 --> 00:22:36,159
involved in these research studies on

645
00:22:39,590 --> 00:22:38,000
the sea floor

646
00:22:41,110 --> 00:22:39,600
um i think there's many different

647
00:22:43,430 --> 00:22:41,120
avenues there's certainly a lot of

648
00:22:45,909 --> 00:22:43,440
programs now that have um

649
00:22:48,950 --> 00:22:45,919
started in the last decade to get

650
00:22:50,950 --> 00:22:48,960
undergraduates involved in research as

651
00:22:53,909 --> 00:22:50,960
and also to get them out to sea

652
00:22:55,830 --> 00:22:53,919
um so there's a variety of different

653
00:22:57,510 --> 00:22:55,840
programs i'd say

654
00:22:59,430 --> 00:22:57,520
contact maybe some of the larger

655
00:23:02,230 --> 00:22:59,440
oceanographic schools

656
00:23:04,230 --> 00:23:02,240
universities they usually have

657
00:23:05,669 --> 00:23:04,240
people going to see and people need

658
00:23:07,110 --> 00:23:05,679
people to join them

659
00:23:10,070 --> 00:23:07,120
if you're more involved in the

660
00:23:12,070 --> 00:23:10,080
technology there's the mate program

661
00:23:15,029 --> 00:23:12,080
that's run out of monterey peninsula

662
00:23:17,909 --> 00:23:15,039
college but it's a broader system now

663
00:23:19,669 --> 00:23:17,919

and that was designed to get people

664
00:23:21,190 --> 00:23:19,679
maybe some of the engineering that have

665
00:23:23,350 --> 00:23:21,200
an engineering background or an

666
00:23:25,909 --> 00:23:23,360
operations background to get some

667
00:23:27,990 --> 00:23:25,919
experience and get to see

668
00:23:31,909 --> 00:23:28,000
so i think there's there's different

669
00:23:35,430 --> 00:23:33,669
yeah i was i was very fortunate as an

670
00:23:37,270 --> 00:23:35,440
undergraduate student i was accepted

671
00:23:39,350 --> 00:23:37,280
into an reu program it's a research

672
00:23:40,870 --> 00:23:39,360
experiences for undergraduates program

673
00:23:43,510 --> 00:23:40,880
at the graduate school of oceanography

674
00:23:45,909 --> 00:23:43,520
in rhode island in narragansett bay

675
00:23:48,390 --> 00:23:45,919
i worked with dr tatiana reinerson

676
00:23:49,909 --> 00:23:48,400
on a project extracting dna from diatoms

677
00:23:52,870 --> 00:23:49,919
from different places around the two

678
00:23:54,950 --> 00:23:52,880
coasts of the continental united states

679
00:23:56,390 --> 00:23:54,960
and many younger people kind of

680
00:23:58,230 --> 00:23:56,400
have used similar programs to get

681
00:23:59,750 --> 00:23:58,240
involved in research as well so yes i

682
00:24:01,909 --> 00:23:59,760
highly recommend those

683
00:24:03,669 --> 00:24:01,919
um so for our audience who are watching

684
00:24:05,510 --> 00:24:03,679
please remember you can ask questions

685
00:24:07,669 --> 00:24:05,520
right now in the chat

686
00:24:10,549 --> 00:24:07,679
on facebook or in youtube if you're

687
00:24:12,390 --> 00:24:10,559
watching there um and you know bring

688
00:24:14,390 --> 00:24:12,400

your questions to dr wheat about all of

689
00:24:16,630 --> 00:24:14,400
his research all of his experience on

690
00:24:18,710 --> 00:24:16,640
the ocean floor and submersibles and in

691
00:24:20,630 --> 00:24:18,720
some of these systems we've discussed

692
00:24:22,310 --> 00:24:20,640
um i always have to kind of relate

693
00:24:23,830 --> 00:24:22,320
things myself to

694
00:24:25,510 --> 00:24:23,840
you know our knowledge of the earth our

695
00:24:27,269 --> 00:24:25,520
knowledge of space what we're doing and

696
00:24:29,269 --> 00:24:27,279
exploring all these different areas but

697
00:24:32,310 --> 00:24:29,279
i also like talking about things like

698
00:24:33,990 --> 00:24:32,320
science fiction and culture um for me i

699
00:24:35,669 --> 00:24:34,000
was very inspired to want to learn how

700
00:24:37,830 --> 00:24:35,679
to dive as a kid and learn more about

701
00:24:38,870 --> 00:24:37,840
the ocean from things like the film the

702
00:24:41,029 --> 00:24:38,880
abyss

703
00:24:43,110 --> 00:24:41,039
um i wonder dr rita is there any

704
00:24:45,909 --> 00:24:43,120
anything in like writing or film that

705
00:24:48,710 --> 00:24:45,919
really inspired you or that you find uh

706
00:24:51,510 --> 00:24:48,720
does a good job of explaining why we go

707
00:24:53,990 --> 00:24:51,520
out to the ocean and explore

708
00:24:55,590 --> 00:24:54,000
oh that's a good question um

709
00:24:56,390 --> 00:24:55,600
i don't know if i have a real answer for

710
00:24:57,990 --> 00:24:56,400
that

711
00:25:00,789 --> 00:24:58,000
um

712
00:25:04,070 --> 00:25:00,799
you know i'm i guess i'm one

713
00:25:06,070 --> 00:25:04,080

uh person that likes doing things um

714
00:25:08,789 --> 00:25:06,080
and and just uh

715
00:25:11,350 --> 00:25:08,799
you know being there and doing that um

716
00:25:12,390 --> 00:25:11,360
and diving and finding different things

717
00:25:14,470 --> 00:25:12,400
um

718
00:25:17,350 --> 00:25:14,480
i started off scuba diving

719
00:25:18,710 --> 00:25:17,360
and like like yourself and going to

720
00:25:20,870 --> 00:25:18,720
shallow root and

721
00:25:23,110 --> 00:25:20,880
uh finding things working on things on

722
00:25:24,710 --> 00:25:23,120
the seafloor mostly uh getting lobster

723
00:25:27,110 --> 00:25:24,720
traps untangled

724
00:25:28,470 --> 00:25:27,120
and other things like that but uh

725
00:25:30,870 --> 00:25:28,480
um

726
00:25:32,070 --> 00:25:30,880
i i don't know if i actually have uh a

727
00:25:33,430 --> 00:25:32,080
nice

728
00:25:36,710 --> 00:25:33,440
you know

729
00:25:37,909 --> 00:25:36,720
sort of movie bent to it

730
00:25:39,510 --> 00:25:37,919
yeah no worries

731
00:25:42,549 --> 00:25:39,520
you know i mean i'm just kind of that

732
00:25:44,230 --> 00:25:42,559
kind of nerd um but i do wonder so uh we

733
00:25:46,310 --> 00:25:44,240
do have some video footage we're sharing

734
00:25:48,630 --> 00:25:46,320
um on the live stream as we discuss

735
00:25:51,029 --> 00:25:48,640
these things um we're wondering if you

736
00:25:53,269 --> 00:25:51,039
can share some of that process of of

737
00:25:54,870 --> 00:25:53,279
sampling from the sea floor um what

738
00:25:57,510 --> 00:25:54,880

that's like with both you know human in

739
00:25:59,190 --> 00:25:57,520
a submersible uh versus a robot what

740
00:26:01,190 --> 00:25:59,200
kinds of materials are you often

741
00:26:04,390 --> 00:26:01,200
collecting uh for your research from the

742
00:26:05,830 --> 00:26:04,400
sea floor um and also i discovered in

743
00:26:08,149 --> 00:26:05,840
talking to prep for the show that

744
00:26:10,070 --> 00:26:08,159
there's uh the capability of taking

745
00:26:12,230 --> 00:26:10,080
samples from the surface from the

746
00:26:14,070 --> 00:26:12,240
subsurface to the surface without taking

747
00:26:16,549 --> 00:26:14,080
the sub back and i'd love to hear more

748
00:26:18,789 --> 00:26:16,559
about that for our audience as well

749
00:26:21,590 --> 00:26:18,799
yeah so so uh

750
00:26:23,669 --> 00:26:21,600
um i guess one of the things i do a lot

751
00:26:25,669 --> 00:26:23,679
of is collect samples

752
00:26:27,669 --> 00:26:25,679
i mostly collect fluids

753
00:26:29,590 --> 00:26:27,679
and

754
00:26:32,149 --> 00:26:29,600
we have different different types of

755
00:26:33,909 --> 00:26:32,159
samplers depending on the fluids if it's

756
00:26:35,750 --> 00:26:33,919
a high temperature fluid you want a

757
00:26:38,470 --> 00:26:35,760
titanium sampler

758
00:26:41,830 --> 00:26:38,480
because it doesn't dissolve or react

759
00:26:43,430 --> 00:26:41,840
even at 300 degrees celsius

760
00:26:45,350 --> 00:26:43,440
on the other hand some of the low

761
00:26:48,070 --> 00:26:45,360
temperature fluids that we collect

762
00:26:50,070 --> 00:26:48,080
are maybe 10 or 15 degrees celsius and

763
00:26:52,710 --> 00:26:50,080

we have special samplers that we make

764
00:26:55,750 --> 00:26:52,720
out of plastics or glass

765
00:26:57,269 --> 00:26:55,760
glass so that we can avoid any organic

766
00:26:58,230 --> 00:26:57,279
contamination

767
00:27:00,230 --> 00:26:58,240
and

768
00:27:01,430 --> 00:27:00,240
some of the low temperature ones

769
00:27:03,590 --> 00:27:01,440
um

770
00:27:05,430 --> 00:27:03,600
are you know we need smaller and smaller

771
00:27:07,269 --> 00:27:05,440
volumes because the analytical aspects

772
00:27:08,630 --> 00:27:07,279
are getting better

773
00:27:09,669 --> 00:27:08,640
so

774
00:27:14,470 --> 00:27:09,679
um

775
00:27:17,190 --> 00:27:14,480
one of the things i've been involved in

776
00:27:17,990 --> 00:27:17,200
is uh scientific ocean drilling

777
00:27:19,750 --> 00:27:18,000
and

778
00:27:21,750 --> 00:27:19,760
in scientific ocean drilling we're able

779
00:27:22,870 --> 00:27:21,760
to drill through the sediment into the

780
00:27:24,549 --> 00:27:22,880
basalt

781
00:27:27,029 --> 00:27:24,559
uh case the hole

782
00:27:29,190 --> 00:27:27,039
and then lower instruments in the hole

783
00:27:32,789 --> 00:27:29,200
that can then sample fluids over a

784
00:27:35,830 --> 00:27:32,799
period of time or discreetly by pumping

785
00:27:38,470 --> 00:27:35,840
on one of the valves and

786
00:27:41,269 --> 00:27:38,480
one of the umbilicals to extract water

787
00:27:42,710 --> 00:27:41,279
from a particular horizon in the hole

788
00:27:44,870 --> 00:27:42,720

so um

789
00:27:46,389 --> 00:27:44,880
as a result we we've had to develop

790
00:27:48,950 --> 00:27:46,399
different ways of

791
00:27:51,750 --> 00:27:48,960
being able to get uh get that water out

792
00:27:53,830 --> 00:27:51,760
and with the holes and as well as

793
00:27:55,830 --> 00:27:53,840
sealing the holes so that it's uh nice

794
00:27:58,549 --> 00:27:55,840
and tight so that we're not getting

795
00:27:59,909 --> 00:27:58,559
extraneous flow from other areas

796
00:28:03,190 --> 00:27:59,919
and um

797
00:28:05,269 --> 00:28:03,200
uh yeah it's uh it's i i've spent many

798
00:28:07,269 --> 00:28:05,279
years um at

799
00:28:09,669 --> 00:28:07,279
with an office at the monterey bay

800
00:28:12,310 --> 00:28:09,679
aquarium research institute and

801
00:28:14,070 --> 00:28:12,320
the one of the good things of

802
00:28:16,470 --> 00:28:14,080
that interaction has been working with

803
00:28:19,350 --> 00:28:16,480
the engineers to help develop some of

804
00:28:22,710 --> 00:28:19,360
these techniques and to advance uh some

805
00:28:27,029 --> 00:28:24,230
yeah that's very cool

806
00:28:28,310 --> 00:28:27,039
um i'm wondering if you if you had a

807
00:28:29,750 --> 00:28:28,320
grant

808
00:28:30,789 --> 00:28:29,760
let's just say like you know a billion

809
00:28:32,950 --> 00:28:30,799
dollars or something just something

810
00:28:33,909 --> 00:28:32,960
crazy um if you had like unlimited

811
00:28:35,830 --> 00:28:33,919
funding

812
00:28:37,990 --> 00:28:35,840
um what would you want to study like

813
00:28:40,070 --> 00:28:38,000

right now in the ocean what's like the

814
00:28:41,269 --> 00:28:40,080
most impressing thing for you right now

815
00:28:43,029 --> 00:28:41,279
in your research that you'd love to

816
00:28:45,830 --> 00:28:43,039
study if you could

817
00:28:48,310 --> 00:28:45,840
so um one of the things that i work with

818
00:28:50,789 --> 00:28:48,320
a lot of microbiologists and one aspect

819
00:28:53,590 --> 00:28:50,799
is what's living in the oceans in the

820
00:28:55,990 --> 00:28:53,600
subsea floor how is it living there

821
00:28:56,870 --> 00:28:56,000
how is it getting transported what sort

822
00:28:59,990 --> 00:28:56,880
of

823
00:29:02,070 --> 00:29:00,000
uh reactions are taking place to

824
00:29:03,990 --> 00:29:02,080
dissolve minerals in one area and

825
00:29:05,110 --> 00:29:04,000
transport the solutes in another area

826
00:29:07,350 --> 00:29:05,120
and so on

827
00:29:09,350 --> 00:29:07,360
and there's a lot of boreholes that have

828
00:29:11,350 --> 00:29:09,360
been drilled in the last 50 years as

829
00:29:14,070 --> 00:29:11,360
part of scientific ocean drilling

830
00:29:16,950 --> 00:29:14,080
and a bunch of them were cased and are

831
00:29:20,630 --> 00:29:16,960
open um at depth

832
00:29:22,710 --> 00:29:20,640
and so i would develop a

833
00:29:25,190 --> 00:29:22,720
sensor sampling system that we could

834
00:29:26,710 --> 00:29:25,200
lower into those bore holes and to be

835
00:29:29,590 --> 00:29:26,720
able to

836
00:29:31,669 --> 00:29:29,600
set up around some of the hydraulic

837
00:29:33,830 --> 00:29:31,679
areas where there's a very permeable

838
00:29:36,149 --> 00:29:33,840

areas where water flows and be able to

839
00:29:38,310 --> 00:29:36,159
sit there and collect that fluid seems

840
00:29:40,389 --> 00:29:38,320
like most of the water that flows

841
00:29:42,389 --> 00:29:40,399
through the ocean crust

842
00:29:43,430 --> 00:29:42,399
occurs in about less than one percent of

843
00:29:46,549 --> 00:29:43,440
the rock

844
00:29:49,269 --> 00:29:46,559
so it's very focused um and to be able

845
00:29:51,110 --> 00:29:49,279
to sample some of that fluid

846
00:29:52,230 --> 00:29:51,120
for both the chemical and microbial

847
00:29:54,389 --> 00:29:52,240
aspects

848
00:29:55,590 --> 00:29:54,399
that sounds pretty incredible um maybe

849
00:29:57,590 --> 00:29:55,600
we'll write that grant and get a billion

850
00:30:00,389 --> 00:29:57,600
dollars

851
00:30:02,470 --> 00:30:00,399
um so so we did talk before the show

852
00:30:05,350 --> 00:30:02,480
uh and i learned that that you've also

853
00:30:08,310 --> 00:30:05,360
developed this this camp uh for young

854
00:30:09,590 --> 00:30:08,320
people to become to get motivated about

855
00:30:12,149 --> 00:30:09,600
marine science to learn about

856
00:30:13,750 --> 00:30:12,159
oceanography um i'm wondering if you can

857
00:30:16,310 --> 00:30:13,760
share a little bit about this camp

858
00:30:18,389 --> 00:30:16,320
you've developed uh and and what you've

859
00:30:21,510 --> 00:30:18,399
experienced in seeing young people

860
00:30:22,789 --> 00:30:21,520
getting interested in in oceanography

861
00:30:25,909 --> 00:30:22,799
well um

862
00:30:27,669 --> 00:30:25,919
i i i do this uh i started this camp

863
00:30:29,510 --> 00:30:27,679

because i wanted to get back

864
00:30:31,830 --> 00:30:29,520
um i've been very

865
00:30:33,430 --> 00:30:31,840
i've been blessed with having the

866
00:30:35,990 --> 00:30:33,440
opportunity to

867
00:30:38,710 --> 00:30:36,000
uh have the career that i've had had the

868
00:30:41,110 --> 00:30:38,720
experience that i i've had and so i

869
00:30:43,669 --> 00:30:41,120
thought one way of giving back would be

870
00:30:45,830 --> 00:30:43,679
to set up a camp um

871
00:30:47,750 --> 00:30:45,840
and most camps are you know you kick a

872
00:30:50,870 --> 00:30:47,760
ball around or

873
00:30:52,470 --> 00:30:50,880
maybe you're coding um and what i wanted

874
00:30:54,149 --> 00:30:52,480
to do is have a

875
00:30:56,710 --> 00:30:54,159
camp that had more technology and

876
00:30:57,830 --> 00:30:56,720
science uh merged and where everything's

877
00:31:02,230 --> 00:30:57,840
hands-on

878
00:31:06,710 --> 00:31:02,240
activities

879
00:31:09,029 --> 00:31:06,720
around the theme of the seafloor and the

880
00:31:11,029 --> 00:31:09,039
science that um is conducted on the

881
00:31:12,070 --> 00:31:11,039
seafloor and the operations that are

882
00:31:15,110 --> 00:31:12,080
required

883
00:31:17,909 --> 00:31:15,120
uh to actually do the do that science

884
00:31:19,110 --> 00:31:17,919
so we've got um uh summer camps

885
00:31:20,950 --> 00:31:19,120
week-long

886
00:31:22,710 --> 00:31:20,960
days summer camps for

887
00:31:24,950 --> 00:31:22,720
third to fifth graders sixth to ninth

888
00:31:27,509 --> 00:31:24,960

graders and then uh last year we

889
00:31:30,149 --> 00:31:27,519
developed one for eight to ten graders

890
00:31:32,630 --> 00:31:30,159
um all different levels of complexity

891
00:31:34,470 --> 00:31:32,640
all with four hands-on activities

892
00:31:36,310 --> 00:31:34,480
per day and

893
00:31:38,710 --> 00:31:36,320
all with the goal of expanding the

894
00:31:40,630 --> 00:31:38,720
understanding of what happens at the sea

895
00:31:42,950 --> 00:31:40,640
floor and sub-sea floor

896
00:31:45,269 --> 00:31:42,960
and uh how you get the

897
00:31:47,430 --> 00:31:45,279
to do the science

898
00:31:49,669 --> 00:31:47,440
that's so cool yeah and in 2019 i was

899
00:31:51,110 --> 00:31:49,679
fortunate i was a leader

900
00:31:53,269 --> 00:31:51,120
for the national geographic student

901
00:31:56,149 --> 00:31:53,279
expeditions uh we took some high school

902
00:31:58,389 --> 00:31:56,159
level students into the boston harbor um

903
00:32:00,070 --> 00:31:58,399
with the massachusetts sea grant uh and

904
00:32:02,310 --> 00:32:00,080
we we had them spend some time

905
00:32:04,230 --> 00:32:02,320
developing uh underwater submersibles

906
00:32:06,070 --> 00:32:04,240
using legos and then they went in and

907
00:32:08,470 --> 00:32:06,080
explored and uh some of them were trying

908
00:32:11,190 --> 00:32:08,480
to catch fish or to use some some bait

909
00:32:12,470 --> 00:32:11,200
to lure crabs over to them others were

910
00:32:14,630 --> 00:32:12,480
trying to answer some scientific

911
00:32:16,470 --> 00:32:14,640
questions about the phytoplankton and

912
00:32:18,070 --> 00:32:16,480
things like that in the water and it was

913
00:32:20,470 --> 00:32:18,080

a really cool experience seeing these

914
00:32:22,149 --> 00:32:20,480
young students kind of engage with the

915
00:32:24,710 --> 00:32:22,159
harbor and engage with you know this

916
00:32:26,470 --> 00:32:24,720
marine life that occurs uh so close to

917
00:32:28,149 --> 00:32:26,480
us so i'm so glad with this camp that

918
00:32:30,389 --> 00:32:28,159
you've developed this way for these

919
00:32:32,549 --> 00:32:30,399
young students to kind of get interested

920
00:32:33,990 --> 00:32:32,559
and to learn about you know sampling and

921
00:32:34,870 --> 00:32:34,000
learning about the ocean and what that

922
00:32:36,789 --> 00:32:34,880
means

923
00:32:38,470 --> 00:32:36,799
um i would like to ask one more question

924
00:32:40,230 --> 00:32:38,480
of my own before we open it up then to

925
00:32:42,389 --> 00:32:40,240
the audience q a

926
00:32:44,549 --> 00:32:42,399
um i'm curious you know you so you've

927
00:32:46,870 --> 00:32:44,559
been a researcher with ambari um there

928
00:32:49,190 --> 00:32:46,880
are various aquaria around the world

929
00:32:51,509 --> 00:32:49,200
where people can go and experience

930
00:32:54,070 --> 00:32:51,519
sea life i'm i'm wondering as someone

931
00:32:56,310 --> 00:32:54,080
who's a researcher who's been out to sea

932
00:32:58,789 --> 00:32:56,320
um if you can speak to the importance of

933
00:33:00,310 --> 00:32:58,799
aquaria um for those who maybe don't

934
00:33:02,950 --> 00:33:00,320
have the opportunity to go out to the

935
00:33:04,950 --> 00:33:02,960
ocean to see marine life and to

936
00:33:07,509 --> 00:33:04,960
understand marine life and what aquaria

937
00:33:09,830 --> 00:33:07,519
are doing for us uh in the science of

938
00:33:13,509 --> 00:33:09,840

understanding the oceans

939
00:33:15,990 --> 00:33:13,519
yeah um aquaria aquariums are

940
00:33:17,990 --> 00:33:16,000
great places for people to go see

941
00:33:19,190 --> 00:33:18,000
organisms that they would never see

942
00:33:21,909 --> 00:33:19,200
otherwise

943
00:33:23,669 --> 00:33:21,919
and the the beauty um

944
00:33:25,830 --> 00:33:23,679
i i know most people when you're on the

945
00:33:27,350 --> 00:33:25,840
beach if you see a jellyfish you know

946
00:33:29,269 --> 00:33:27,360
you run

947
00:33:31,830 --> 00:33:29,279
you don't want to get stung but uh they

948
00:33:35,350 --> 00:33:31,840
are just beautiful creatures and

949
00:33:36,950 --> 00:33:35,360
an aquarium sets that into place um

950
00:33:39,269 --> 00:33:36,960
one of one of the interesting things

951
00:33:41,590 --> 00:33:39,279
about the summer camp is we take little

952
00:33:42,950 --> 00:33:41,600
off we take rovs and we put them in

953
00:33:44,549 --> 00:33:42,960
monterey harbor

954
00:33:46,789 --> 00:33:44,559
um and

955
00:33:49,269 --> 00:33:46,799
you know the the kids most of the kids

956
00:33:51,430 --> 00:33:49,279
have been to the aquarium and then they

957
00:33:53,350 --> 00:33:51,440
go and put the rovs in the water and see

958
00:33:56,070 --> 00:33:53,360
different things you know you might see

959
00:33:57,190 --> 00:33:56,080
a shoe or a can or something else where

960
00:34:00,310 --> 00:33:57,200
you're not going to see that at the

961
00:34:02,389 --> 00:34:00,320
aquarium but but they do see all the

962
00:34:04,230 --> 00:34:02,399
organisms but in the aquarium you

963
00:34:05,509 --> 00:34:04,240

actually get to see them up close and

964
00:34:19,190 --> 00:34:05,519
personal and

965
00:34:23,109 --> 00:34:20,230
um

966
00:34:25,990 --> 00:34:23,119
are engaged in conservation and other

967
00:34:27,589 --> 00:34:26,000
efforts and both sample collection

968
00:34:30,149 --> 00:34:27,599
as well as

969
00:34:32,470 --> 00:34:30,159
letting people know what what

970
00:34:35,270 --> 00:34:32,480
what is important in the ocean

971
00:34:37,349 --> 00:34:35,280
to be able to conserve what we have or

972
00:34:38,389 --> 00:34:37,359
to maintain what we have

973
00:34:39,669 --> 00:34:38,399
um

974
00:34:42,550 --> 00:34:39,679
and

975
00:34:44,550 --> 00:34:42,560
uh yeah i i grew up on the east coast

976
00:34:45,669 --> 00:34:44,560
and when i was a kid there was plenty of

977
00:34:48,710 --> 00:34:45,679
cod

978
00:34:51,030 --> 00:34:48,720
uh there isn't any more um

979
00:34:52,389 --> 00:34:51,040
and if we had a little more conservation

980
00:34:54,869 --> 00:34:52,399
back then

981
00:34:56,550 --> 00:34:54,879
you know maybe that wouldn't be the case

982
00:34:58,870 --> 00:34:56,560
yeah it's so crucial i think for a lot

983
00:35:00,630 --> 00:34:58,880
of people to learn about fisheries and

984
00:35:02,230 --> 00:35:00,640
about what we have done to marine

985
00:35:04,710 --> 00:35:02,240
organisms around the world in our

986
00:35:06,390 --> 00:35:04,720
fishing and in some cases overfishing

987
00:35:08,069 --> 00:35:06,400
and cod is one of the best examples i

988
00:35:10,790 --> 00:35:08,079

think of that occurring in the ocean

989
00:35:12,870 --> 00:35:10,800
there are certainly many others as well

990
00:35:15,349 --> 00:35:12,880
so thank you very much for that i am

991
00:35:17,109 --> 00:35:15,359
going to open it up now to our audience

992
00:35:19,670 --> 00:35:17,119
so for those watching on the nasa

993
00:35:21,750 --> 00:35:19,680
astrobiology facebook or on the nasa

994
00:35:24,069 --> 00:35:21,760
astrobiology youtube channel feel free

995
00:35:25,990 --> 00:35:24,079
to ask your questions in the chat

996
00:35:29,030 --> 00:35:26,000
we will try to load them into our queue

997
00:35:31,030 --> 00:35:29,040
here for us to discuss with dr reed

998
00:35:33,589 --> 00:35:31,040
the first question i'd like to ask comes

999
00:35:36,069 --> 00:35:33,599
from a longtime viewer of our show who

1000
00:35:38,470 --> 00:35:36,079
is very intrigued by the ocean worlds of

1001
00:35:40,550 --> 00:35:38,480
our solar system specifically places

1002
00:35:42,630 --> 00:35:40,560
like europa and enceladus

1003
00:35:44,230 --> 00:35:42,640
this is tom caruso

1004
00:35:45,349 --> 00:35:44,240
tom would like to know if you can

1005
00:35:47,430 --> 00:35:45,359
compare

1006
00:35:50,390 --> 00:35:47,440
um hydrothermal vents at the bottom of

1007
00:35:53,109 --> 00:35:50,400
earth's oceans to possible ones at in

1008
00:35:55,990 --> 00:35:53,119
these low gravity moons uh on enceladus

1009
00:35:58,230 --> 00:35:56,000
and europa um what kinds of differences

1010
00:35:59,990 --> 00:35:58,240
do you think we should expect in a place

1011
00:36:02,870 --> 00:36:00,000
like europa or enceladus versus the

1012
00:36:07,190 --> 00:36:02,880
earth's hydrothermal vent systems

1013
00:36:10,829 --> 00:36:07,200

um that's a good question um i guess the

1014
00:36:14,630 --> 00:36:13,670
what's what's the core doing

1015
00:36:16,069 --> 00:36:14,640
um

1016
00:36:19,990 --> 00:36:16,079
on these moons

1017
00:36:21,670 --> 00:36:20,000
is it uh convecting is it stable um

1018
00:36:23,349 --> 00:36:21,680
and so on and so forth and that's going

1019
00:36:25,030 --> 00:36:23,359
to have an effect as to how the heat

1020
00:36:28,230 --> 00:36:25,040
gets distributed

1021
00:36:30,790 --> 00:36:28,240
and as long as you can convect

1022
00:36:33,829 --> 00:36:30,800
in a core like or in the mantle here on

1023
00:36:36,390 --> 00:36:33,839
earth where you get to move heat around

1024
00:36:38,390 --> 00:36:36,400
um then you can have the aspect or the

1025
00:36:41,910 --> 00:36:38,400
potential for having higher temperature

1026
00:36:45,109 --> 00:36:41,920
fluids um much more so than

1027
00:36:46,870 --> 00:36:45,119
um if it's a you know nice solid feature

1028
00:36:48,630 --> 00:36:46,880
where you um

1029
00:36:50,870 --> 00:36:48,640
can't really penetrate

1030
00:36:52,950 --> 00:36:50,880
uh faults are also very important how

1031
00:36:53,750 --> 00:36:52,960
how faulted is the system

1032
00:36:54,870 --> 00:36:53,760
so

1033
00:36:57,349 --> 00:36:54,880
um

1034
00:36:59,990 --> 00:36:57,359
yeah it'll be interesting to see how

1035
00:37:03,670 --> 00:37:00,000
how once we get um more information from

1036
00:37:06,230 --> 00:37:03,680
flybys and orbiting uh satellites

1037
00:37:08,950 --> 00:37:06,240
um what we learn more about the inner

1038
00:37:10,470 --> 00:37:08,960

workings of those moons

1039
00:37:11,990 --> 00:37:10,480
yeah and that's a good point so we

1040
00:37:14,230 --> 00:37:12,000
should remind the audience we have an

1041
00:37:16,950 --> 00:37:14,240
upcoming mission nasa's europa clipper

1042
00:37:19,190 --> 00:37:16,960
mission is going to go to europa it's

1043
00:37:20,230 --> 00:37:19,200
going to orbit around jupiter and europa

1044
00:37:22,390 --> 00:37:20,240
together

1045
00:37:23,510 --> 00:37:22,400
it's not going to be diving down into

1046
00:37:25,109 --> 00:37:23,520
the ocean

1047
00:37:27,349 --> 00:37:25,119
um but it will teach us a lot more about

1048
00:37:30,069 --> 00:37:27,359
europa's surface we'll use instruments

1049
00:37:31,910 --> 00:37:30,079
to better detect the extent of europa's

1050
00:37:34,630 --> 00:37:31,920
ocean to study the chemistry of the

1051
00:37:36,230 --> 00:37:34,640
surface of europa if there are plumes

1052
00:37:38,230 --> 00:37:36,240
there's been some hypotheses and some

1053
00:37:40,150 --> 00:37:38,240
data from telescopes to suggest there

1054
00:37:41,030 --> 00:37:40,160
could be plumes of fluid at europa as

1055
00:37:42,790 --> 00:37:41,040
well

1056
00:37:44,870 --> 00:37:42,800
then clipper has an instrument that will

1057
00:37:45,990 --> 00:37:44,880
allow them to sample materials from

1058
00:37:47,589 --> 00:37:46,000
plumes

1059
00:37:49,190 --> 00:37:47,599
that same instrument will study the dust

1060
00:37:51,030 --> 00:37:49,200
and the material environment around

1061
00:37:53,190 --> 00:37:51,040
europa as well so

1062
00:37:55,910 --> 00:37:53,200
there are upcoming missions currently

1063
00:37:58,870 --> 00:37:55,920

nothing is planned uh nothing is paid

1064
00:38:01,030 --> 00:37:58,880
for is going to enceladus but uh there

1065
00:38:02,710 --> 00:38:01,040
are some cool ideas in the works from

1066
00:38:04,390 --> 00:38:02,720
various researchers of icy worlds for

1067
00:38:06,230 --> 00:38:04,400
getting out and studying

1068
00:38:08,710 --> 00:38:06,240
enceladus again as well and some of the

1069
00:38:10,470 --> 00:38:08,720
other ocean worlds um

1070
00:38:11,910 --> 00:38:10,480
i would like to share a question now our

1071
00:38:14,069 --> 00:38:11,920
senior production assistant sarah

1072
00:38:15,589 --> 00:38:14,079
treadwell i asked her own question uh

1073
00:38:16,870 --> 00:38:15,599
sarah wants to know since you've

1074
00:38:19,670 --> 00:38:16,880
traveled and you've been to all these

1075
00:38:21,990 --> 00:38:19,680
various locations um on the ocean uh

1076
00:38:24,710 --> 00:38:22,000
what is your favorite location in which

1077
00:38:26,150 --> 00:38:24,720
you've gotten to do research thus far

1078
00:38:29,349 --> 00:38:26,160
oh

1079
00:38:34,470 --> 00:38:29,359
uh that's a good one um

1080
00:38:37,990 --> 00:38:36,069
uh

1081
00:38:39,510 --> 00:38:38,000
you're pretty much everything looks the

1082
00:38:41,270 --> 00:38:39,520
same

1083
00:38:43,750 --> 00:38:41,280
there's a lot of blue

1084
00:38:46,390 --> 00:38:43,760
blue water blue sky and so on and so

1085
00:38:47,670 --> 00:38:46,400
forth but um once you get underneath

1086
00:38:50,630 --> 00:38:47,680
the blue

1087
00:38:54,550 --> 00:38:50,640
water in the sky and on the sea floor

1088
00:38:56,870 --> 00:38:54,560

um i i think uh the mud volcanoes um

1089
00:38:58,710 --> 00:38:56,880
where you know

1090
00:39:01,109 --> 00:38:58,720
they're coming up um i think that's the

1091
00:39:03,510 --> 00:39:01,119
most fascinating because

1092
00:39:06,230 --> 00:39:03,520
i i don't understand it as much

1093
00:39:06,950 --> 00:39:06,240
or as well as some of the other places

1094
00:39:14,390 --> 00:39:06,960
and

1095
00:39:15,670 --> 00:39:14,400
samples

1096
00:39:17,349 --> 00:39:15,680
uh from

1097
00:39:18,790 --> 00:39:17,359
from that environment

1098
00:39:20,870 --> 00:39:18,800
relative to let's say high temperature

1099
00:39:22,870 --> 00:39:20,880
hydrothermal systems or or even ridge

1100
00:39:23,670 --> 00:39:22,880
flank hydrothermal systems

1101
00:39:26,310 --> 00:39:23,680
so

1102
00:39:29,030 --> 00:39:26,320
i would i think that be uh i put that

1103
00:39:31,030 --> 00:39:29,040
place as number one that's awesome yeah

1104
00:39:33,030 --> 00:39:31,040
it's so cool when you do a research it

1105
00:39:34,310 --> 00:39:33,040
gives you a chance uh if you're into you

1106
00:39:36,950 --> 00:39:34,320
know traveling in the world and learning

1107
00:39:38,390 --> 00:39:36,960
about unique systems um you can do that

1108
00:39:39,589 --> 00:39:38,400
as a researcher

1109
00:39:42,550 --> 00:39:39,599
and that kind of leads to my next

1110
00:39:43,589 --> 00:39:42,560
question then uh user mr praximus on

1111
00:39:47,030 --> 00:39:43,599
youtube

1112
00:39:49,109 --> 00:39:47,040
uh asks this uh as a master's degree

1113
00:39:52,150 --> 00:39:49,119

marine biologist who wants to continue

1114
00:39:54,310 --> 00:39:52,160
into a phd in deep marine biology uh

1115
00:39:57,109 --> 00:39:54,320
specifically with usage of rovs and

1116
00:39:58,790 --> 00:39:57,119
other technologies uh user mr proximus

1117
00:40:01,990 --> 00:39:58,800
wants to know

1118
00:40:03,990 --> 00:40:02,000
what subjects might they want follow

1119
00:40:05,910 --> 00:40:04,000
in order to better develop a good phd

1120
00:40:07,910 --> 00:40:05,920
project that allows them to go out and

1121
00:40:10,470 --> 00:40:07,920
do deep marine biology with rovs and

1122
00:40:12,790 --> 00:40:10,480
such

1123
00:40:14,710 --> 00:40:12,800
i'm i'm a firm believer

1124
00:40:15,670 --> 00:40:14,720
that uh you need to know the fundamental

1125
00:40:18,630 --> 00:40:15,680
science

1126
00:40:20,150 --> 00:40:18,640
uh before you get in more in the broader

1127
00:40:23,829 --> 00:40:20,160
application so

1128
00:40:25,430 --> 00:40:23,839
so for me um chemistry and geology is

1129
00:40:27,510 --> 00:40:25,440
important

1130
00:40:30,550 --> 00:40:27,520
if you're into fluid flow you know

1131
00:40:32,390 --> 00:40:30,560
physics is important biology

1132
00:40:34,470 --> 00:40:32,400
making sure you understand the basics of

1133
00:40:36,470 --> 00:40:34,480
biology and ecology

1134
00:40:38,550 --> 00:40:36,480
and how

1135
00:40:40,630 --> 00:40:38,560
how life works fundamentally

1136
00:40:42,069 --> 00:40:40,640
um the ocean is just another aspect of

1137
00:40:43,750 --> 00:40:42,079
it um

1138
00:40:47,190 --> 00:40:43,760

it's just an application of the

1139
00:40:50,630 --> 00:40:47,200
fundamental uh processes that you

1140
00:40:53,270 --> 00:40:50,640
you learn about so i would say a solid

1141
00:40:55,190 --> 00:40:53,280
foundation in basic science

1142
00:40:57,030 --> 00:40:55,200
is a is a great start

1143
00:40:59,589 --> 00:40:57,040
and then if you're um

1144
00:41:01,270 --> 00:40:59,599
you know then to go to grad school in

1145
00:41:02,309 --> 00:41:01,280
one of these fields

1146
00:41:03,190 --> 00:41:02,319
um

1147
00:41:04,710 --> 00:41:03,200
you know

1148
00:41:06,550 --> 00:41:04,720
uh there's

1149
00:41:08,550 --> 00:41:06,560
quite a few oceanographic institutions

1150
00:41:11,270 --> 00:41:08,560
or ocean institutions that have

1151
00:41:13,109 --> 00:41:11,280
oceanographic uh programs

1152
00:41:14,950 --> 00:41:13,119
and find someone who's been doing

1153
00:41:15,990 --> 00:41:14,960
deep-sea research and goes out to sea a

1154
00:41:18,470 --> 00:41:16,000
lot

1155
00:41:21,589 --> 00:41:18,480
um because they typically keep going out

1156
00:41:23,670 --> 00:41:21,599
to sea um and there's a lot of people

1157
00:41:25,430 --> 00:41:23,680
doing a lot of fun stuff

1158
00:41:27,109 --> 00:41:25,440
um

1159
00:41:29,190 --> 00:41:27,119
especially even now in the trenches

1160
00:41:31,510 --> 00:41:29,200
there's a bunch of work that's really

1161
00:41:32,950 --> 00:41:31,520
deep sea

1162
00:41:34,069 --> 00:41:32,960
it's very cool yeah it makes i don't

1163
00:41:35,589 --> 00:41:34,079

ever hear about that i want to go down

1164
00:41:36,630 --> 00:41:35,599
to deepsea as well go study some of

1165
00:41:39,190 --> 00:41:36,640
those things

1166
00:41:43,109 --> 00:41:39,200
um we have a similar question from user

1167
00:41:44,790 --> 00:41:43,119
niall gakewood uh gaekwad on youtube uh

1168
00:41:47,349 --> 00:41:44,800
niall says that they're currently doing

1169
00:41:49,270 --> 00:41:47,359
a masters in biochemistry and is

1170
00:41:51,910 --> 00:41:49,280
immensely interested in astrobiology

1171
00:41:53,589 --> 00:41:51,920
intending to do a phd um their question

1172
00:41:56,309 --> 00:41:53,599
is what steps would you suggest to take

1173
00:41:57,910 --> 00:41:56,319
to enter this field um but i think

1174
00:41:59,910 --> 00:41:57,920
you've kind of already answered that to

1175
00:42:02,470 --> 00:41:59,920
a degree so i'd like to add to what

1176
00:42:05,030 --> 00:42:02,480
niall is asking and actually ask you

1177
00:42:07,030 --> 00:42:05,040
about the importance of mentorship

1178
00:42:08,870 --> 00:42:07,040
in your own career and for some of these

1179
00:42:10,710 --> 00:42:08,880
younger students doing master's degrees

1180
00:42:12,950 --> 00:42:10,720
or undergraduate degrees who want to

1181
00:42:14,710 --> 00:42:12,960
earn phds

1182
00:42:17,270 --> 00:42:14,720
what's your vision of the importance of

1183
00:42:18,390 --> 00:42:17,280
finding a mentor to enter this field as

1184
00:42:20,710 --> 00:42:18,400
well

1185
00:42:21,829 --> 00:42:20,720
i i would say a mentor is very important

1186
00:42:24,550 --> 00:42:21,839
um

1187
00:42:27,270 --> 00:42:24,560
i've seen people that have

1188
00:42:28,870 --> 00:42:27,280

if you have a mentor it makes everything

1189
00:42:30,790 --> 00:42:28,880
everything work

1190
00:42:33,190 --> 00:42:30,800
because they will know what you need to

1191
00:42:34,309 --> 00:42:33,200
know and what you need to do and how to

1192
00:42:36,950 --> 00:42:34,319
do it and

1193
00:42:38,150 --> 00:42:36,960
and can antagonize you or you know

1194
00:42:40,550 --> 00:42:38,160
promote you

1195
00:42:42,150 --> 00:42:40,560
um in a direction

1196
00:42:47,829 --> 00:42:42,160
um

1197
00:42:49,109 --> 00:42:47,839
and so having a mentor is uh is very

1198
00:42:51,829 --> 00:42:49,119
important

1199
00:42:54,390 --> 00:42:51,839
um i think over the years people have

1200
00:42:56,309 --> 00:42:54,400
become more aware of the

1201
00:42:59,190 --> 00:42:56,319
need for strong mentorship

1202
00:43:02,069 --> 00:42:59,200
um in in university settings so

1203
00:43:03,990 --> 00:43:02,079
uh that's always good um and it doesn't

1204
00:43:07,190 --> 00:43:04,000
necessarily have to be

1205
00:43:09,030 --> 00:43:07,200
um you you know your advisor it could be

1206
00:43:11,670 --> 00:43:09,040
a post-doc or a senior

1207
00:43:15,510 --> 00:43:11,680
uh graduate student uh can come in and

1208
00:43:17,030 --> 00:43:15,520
act as a mentor just as well as uh as

1209
00:43:20,069 --> 00:43:17,040
the pi

1210
00:43:22,150 --> 00:43:20,079
so um or or even uh someone who's been

1211
00:43:23,430 --> 00:43:22,160
in the lab is a tech in a technical

1212
00:43:25,510 --> 00:43:23,440
capacity

1213
00:43:28,069 --> 00:43:25,520

you know it's just uh

1214
00:43:29,349 --> 00:43:28,079
putting it in so um mentorship is very

1215
00:43:30,790 --> 00:43:29,359
important

1216
00:43:33,510 --> 00:43:30,800
and um

1217
00:43:35,910 --> 00:43:33,520
it can really help out your career

1218
00:43:37,829 --> 00:43:35,920
or or and also guide you in different

1219
00:43:39,430 --> 00:43:37,839
directions um

1220
00:43:40,950 --> 00:43:39,440
you know or make you aware of different

1221
00:43:42,390 --> 00:43:40,960
directions sometimes we get a little

1222
00:43:44,150 --> 00:43:42,400
tunnel vision

1223
00:43:45,750 --> 00:43:44,160
as to uh

1224
00:43:47,829 --> 00:43:45,760
we think we want to go in this direction

1225
00:43:49,109 --> 00:43:47,839
and we're unaware of other potential

1226
00:43:51,190 --> 00:43:49,119
directions

1227
00:43:53,109 --> 00:43:51,200
and so having

1228
00:43:55,109 --> 00:43:53,119
those possibilities put out to us too is

1229
00:43:57,270 --> 00:43:55,119
is always good

1230
00:43:58,710 --> 00:43:57,280
that's a great point i i was inspired

1231
00:44:00,710 --> 00:43:58,720
when i was younger i was earning degrees

1232
00:44:03,030 --> 00:44:00,720
in biology and chemistry and i was

1233
00:44:05,270 --> 00:44:03,040
inspired by peter diamandis to go on and

1234
00:44:07,750 --> 00:44:05,280
study astrophysics and then to earn my

1235
00:44:09,589 --> 00:44:07,760
phd in geology to to allow myself to

1236
00:44:10,950 --> 00:44:09,599
transition through several different

1237
00:44:12,630 --> 00:44:10,960
fields of study

1238
00:44:13,589 --> 00:44:12,640

which i found very helpful in the long

1239
00:44:15,109 --> 00:44:13,599
run and

1240
00:44:17,430 --> 00:44:15,119
in mentorship i've been very lucky

1241
00:44:18,790 --> 00:44:17,440
myself to mentor various students and be

1242
00:44:20,950 --> 00:44:18,800
involved in their lives and watch their

1243
00:44:22,630 --> 00:44:20,960
careers grow one person i've watched

1244
00:44:25,270 --> 00:44:22,640
grow a lot is our production assistant

1245
00:44:27,829 --> 00:44:25,280
america mahanti uh anna roop also has

1246
00:44:29,990 --> 00:44:27,839
asked a question for you um and i i kind

1247
00:44:31,510 --> 00:44:30,000
of like his wording here uh he says what

1248
00:44:33,910 --> 00:44:31,520
are the major challenges uh

1249
00:44:35,270 --> 00:44:33,920
technological or physical in exploring

1250
00:44:37,829 --> 00:44:35,280
the sea floor

1251
00:44:40,390 --> 00:44:37,839
but he adds to that uh is there any

1252
00:44:42,069 --> 00:44:40,400
challenge in exploring the ocean

1253
00:44:45,109 --> 00:44:42,079
that might be similar to how we have a

1254
00:44:46,630 --> 00:44:45,119
cosmic speed limit for space exploration

1255
00:44:49,030 --> 00:44:46,640
so like at the fundamental level is

1256
00:44:52,230 --> 00:44:49,040
there something really challenging about

1257
00:44:56,260 --> 00:44:54,870
oh well um

1258
00:44:57,510 --> 00:44:56,270
yeah i think it's uh

1259
00:44:59,910 --> 00:44:57,520
[Music]

1260
00:45:02,829 --> 00:44:59,920
time on the seafloor um

1261
00:45:04,390 --> 00:45:02,839
and how fast the vehicles can move

1262
00:45:06,230 --> 00:45:04,400
um

1263
00:45:08,470 --> 00:45:06,240

and uh the nice thing about well

1264
00:45:11,510 --> 00:45:08,480
submarines you're sort of limited to

1265
00:45:14,230 --> 00:45:11,520
about five hours a day on the seafloor

1266
00:45:15,990 --> 00:45:14,240
uh with an rov uh you can have it down

1267
00:45:16,870 --> 00:45:16,000
for 24 hours a day

1268
00:45:18,950 --> 00:45:16,880
um

1269
00:45:21,430 --> 00:45:18,960
and we've had in our we've had jason

1270
00:45:23,510 --> 00:45:21,440
which is an rov run out of woods hole

1271
00:45:26,150 --> 00:45:23,520
uh massachusetts um

1272
00:45:27,670 --> 00:45:26,160
uh that that one has been down we've had

1273
00:45:28,870 --> 00:45:27,680
it down for a week

1274
00:45:30,710 --> 00:45:28,880
and

1275
00:45:32,470 --> 00:45:30,720
um as

1276
00:45:34,230 --> 00:45:32,480
one of the questions earlier what we do

1277
00:45:35,349 --> 00:45:34,240
is we send samplers down with an

1278
00:45:39,670 --> 00:45:35,359
elevator

1279
00:45:41,750 --> 00:45:39,680
send samples down it sinks to the sea

1280
00:45:43,270 --> 00:45:41,760
floor the rov goes over takes the

1281
00:45:45,990 --> 00:45:43,280
samples off

1282
00:45:47,109 --> 00:45:46,000
and then um you go collect your samples

1283
00:45:49,750 --> 00:45:47,119
put your

1284
00:45:51,510 --> 00:45:49,760
your samples back on the elevator comes

1285
00:45:53,750 --> 00:45:51,520
up to the surface and you take them off

1286
00:45:55,270 --> 00:45:53,760
the ship and analyze them and recycle

1287
00:45:56,390 --> 00:45:55,280
that um

1288
00:45:58,550 --> 00:45:56,400

and

1289
00:46:01,829 --> 00:45:58,560
even with that process even having the

1290
00:46:03,349 --> 00:46:01,839
extra hours you can't really cover a lot

1291
00:46:05,910 --> 00:46:03,359
of ground

1292
00:46:07,430 --> 00:46:05,920
and it's a miniscule amount of seafloor

1293
00:46:10,309 --> 00:46:07,440
relative to

1294
00:46:11,829 --> 00:46:10,319
the sea floor on the earth

1295
00:46:14,630 --> 00:46:11,839
we um

1296
00:46:16,390 --> 00:46:14,640
where the octopuses were on the seafloor

1297
00:46:17,910 --> 00:46:16,400
we spent you know

1298
00:46:20,150 --> 00:46:17,920
i think three weeks

1299
00:46:21,109 --> 00:46:20,160
diving all the time on this one feature

1300
00:46:23,510 --> 00:46:21,119
that's

1301
00:46:25,109 --> 00:46:23,520
about a kilometer long and half a

1302
00:46:26,630 --> 00:46:25,119
kilometer wide

1303
00:46:28,390 --> 00:46:26,640
and

1304
00:46:31,190 --> 00:46:28,400
you know it took that amount of time

1305
00:46:32,630 --> 00:46:31,200
just to do that small portion of the

1306
00:46:33,750 --> 00:46:32,640
seafloor so

1307
00:46:36,390 --> 00:46:33,760
um

1308
00:46:40,309 --> 00:46:36,400
if there was some way we could automate

1309
00:46:41,990 --> 00:46:40,319
um make things a little faster um and

1310
00:46:45,270 --> 00:46:42,000
you know see the sea floor that'd be

1311
00:46:47,670 --> 00:46:45,280
great one option or one way uh the sort

1312
00:46:50,309 --> 00:46:47,680
of the community is moving is

1313
00:46:51,589 --> 00:46:50,319

uh through autonomous vehicles

1314
00:46:54,069 --> 00:46:51,599
and um

1315
00:46:56,230 --> 00:46:54,079
the upside of that is you can cover a

1316
00:46:57,430 --> 00:46:56,240
lot more ground with a bunch of smaller

1317
00:47:00,550 --> 00:46:57,440
vehicles

1318
00:47:03,030 --> 00:47:00,560
and the downside is again the cost and

1319
00:47:04,390 --> 00:47:03,040
the engineering capabilities and so on

1320
00:47:05,750 --> 00:47:04,400
and so forth to actually make that

1321
00:47:06,710 --> 00:47:05,760
happen

1322
00:47:08,710 --> 00:47:06,720
so

1323
00:47:10,390 --> 00:47:08,720
i i guess it's a matter of how much

1324
00:47:11,670 --> 00:47:10,400
space you can

1325
00:47:12,550 --> 00:47:11,680
actually

1326
00:47:14,470 --> 00:47:12,560
see

1327
00:47:17,349 --> 00:47:14,480
currently you know

1328
00:47:18,950 --> 00:47:17,359
see on the sea floor right now

1329
00:47:21,030 --> 00:47:18,960
and as you mentioned it's so little that

1330
00:47:22,150 --> 00:47:21,040
we've explored um and that kind of

1331
00:47:23,829 --> 00:47:22,160
intrigues me it makes me think you know

1332
00:47:26,309 --> 00:47:23,839
much as like right now we have folks at

1333
00:47:29,510 --> 00:47:26,319
nasa who are sitting in command rooms at

1334
00:47:31,910 --> 00:47:29,520
places like jpl and sending commands you

1335
00:47:33,510 --> 00:47:31,920
know via radio wave to mars and then

1336
00:47:35,190 --> 00:47:33,520
they're they're telling our rovers what

1337
00:47:37,750 --> 00:47:35,200
to do on the surface of mars from so far

1338
00:47:39,990 --> 00:47:37,760

away but but even in space exploration

1339
00:47:42,069 --> 00:47:40,000
you know with rovers and orbiters we are

1340
00:47:42,790 --> 00:47:42,079
trying to automate more and more so that

1341
00:47:46,950 --> 00:47:42,800
the

1342
00:47:49,270 --> 00:47:46,960
more data and know how to collect more

1343
00:47:51,109 --> 00:47:49,280
data on its own and know how to avoid

1344
00:47:52,470 --> 00:47:51,119
hazards and things like that and so that

1345
00:47:54,790 --> 00:47:52,480
makes me wonder in the future could we

1346
00:47:56,230 --> 00:47:54,800
see like a submersible being guided by

1347
00:47:58,230 --> 00:47:56,240
people sitting in a command room at

1348
00:47:59,349 --> 00:47:58,240
their local university and the rover's

1349
00:48:00,870 --> 00:47:59,359
out in the middle of the ocean just

1350
00:48:02,390 --> 00:48:00,880
doing its own thing

1351
00:48:04,230 --> 00:48:02,400
um it's kind of cool to think about i'm

1352
00:48:06,470 --> 00:48:04,240
glad you mentioned the elevator system

1353
00:48:09,109 --> 00:48:06,480
for bringing samples up and down that's

1354
00:48:10,870 --> 00:48:09,119
not unlike how nasa perseverance the

1355
00:48:12,309 --> 00:48:10,880
river right now is collecting and

1356
00:48:14,150 --> 00:48:12,319
caching samples that we're going to

1357
00:48:15,030 --> 00:48:14,160
eventually go pick up and bring back to

1358
00:48:17,589 --> 00:48:15,040
earth

1359
00:48:19,910 --> 00:48:17,599
um to study and it's a really important

1360
00:48:21,910 --> 00:48:19,920
question you know as researchers it's so

1361
00:48:24,069 --> 00:48:21,920
helpful when we have the sample in our

1362
00:48:25,910 --> 00:48:24,079
hand to work with we can take it to

1363
00:48:27,910 --> 00:48:25,920

specialized instruments we can share it

1364
00:48:30,150 --> 00:48:27,920
amongst different research groups

1365
00:48:31,349 --> 00:48:30,160
and i myself i've been very blessed

1366
00:48:33,430 --> 00:48:31,359
previously

1367
00:48:35,750 --> 00:48:33,440
through a nasa an exit biology grant to

1368
00:48:38,150 --> 00:48:35,760
travel to the arctic and collect samples

1369
00:48:41,030 --> 00:48:38,160
add a field site a planetary analog and

1370
00:48:43,349 --> 00:48:41,040
bring them back to america to study

1371
00:48:45,190 --> 00:48:43,359
and so our next question comes from user

1372
00:48:46,710 --> 00:48:45,200
erin avapidar

1373
00:48:48,710 --> 00:48:46,720
it's an important question that many of

1374
00:48:50,230 --> 00:48:48,720
us who've retrieved samples and have

1375
00:48:52,470 --> 00:48:50,240
brought them back to the laboratory have

1376
00:48:54,390 --> 00:48:52,480
had to ask ourselves uh to make sure

1377
00:48:56,549 --> 00:48:54,400
that we're being true to the science uh

1378
00:48:59,109 --> 00:48:56,559
erinova wants to know

1379
00:49:01,270 --> 00:48:59,119
how is the condition of the fluid

1380
00:49:03,349 --> 00:49:01,280
samples and i'll add any samples that

1381
00:49:05,430 --> 00:49:03,359
you collect uh things like ph

1382
00:49:07,030 --> 00:49:05,440
temperature mineralogy

1383
00:49:09,030 --> 00:49:07,040
how are these conditions when they're

1384
00:49:11,270 --> 00:49:09,040
collected near the sea floor

1385
00:49:12,549 --> 00:49:11,280
maintained during the journey from the

1386
00:49:14,790 --> 00:49:12,559
ocean

1387
00:49:17,510 --> 00:49:14,800
back to the ship and then and then from

1388
00:49:18,950 --> 00:49:17,520

the ship back to the laboratory um how

1389
00:49:20,870 --> 00:49:18,960
do we make sure that we are actually

1390
00:49:22,710 --> 00:49:20,880
studying the right thing from the

1391
00:49:25,270 --> 00:49:22,720
seafloor

1392
00:49:28,549 --> 00:49:25,280
well that's a good question and and the

1393
00:49:31,589 --> 00:49:28,559
reality is is uh we do our best

1394
00:49:32,710 --> 00:49:31,599
um in the case of fluids and what i do

1395
00:49:34,230 --> 00:49:32,720
um

1396
00:49:36,870 --> 00:49:34,240
it's

1397
00:49:37,670 --> 00:49:36,880
typically reactions don't occur very

1398
00:49:39,430 --> 00:49:37,680
much

1399
00:49:41,829 --> 00:49:39,440
or not at all

1400
00:49:44,630 --> 00:49:41,839
um and there's ways of preserving adding

1401
00:49:46,870 --> 00:49:44,640
a preservative whether it be in my case

1402
00:49:49,349 --> 00:49:46,880
adding some acid to the sampler on the

1403
00:49:51,510 --> 00:49:49,359
sea floor to keep whatever solutes are

1404
00:49:53,910 --> 00:49:51,520
there in solution

1405
00:49:56,710 --> 00:49:53,920
for microbiology that's another question

1406
00:49:58,150 --> 00:49:56,720
there's a whole new focus of

1407
00:50:00,309 --> 00:49:58,160
trying to collect the samples and

1408
00:50:02,630 --> 00:50:00,319
pressurized uh systems

1409
00:50:05,190 --> 00:50:02,640
because pressure can influence

1410
00:50:06,549 --> 00:50:05,200
um the microbial communities and in

1411
00:50:07,510 --> 00:50:06,559
their activity

1412
00:50:13,349 --> 00:50:07,520
so

1413
00:50:15,430 --> 00:50:13,359

sediment uh we do know if it's a

1414
00:50:17,510 --> 00:50:15,440
carbonate rich sediment it will exchange

1415
00:50:20,230 --> 00:50:17,520
with the pore waters on the way up

1416
00:50:22,069 --> 00:50:20,240
um and it's in very you know you're

1417
00:50:24,150 --> 00:50:22,079
taking it from a two degree environment

1418
00:50:26,790 --> 00:50:24,160
and bring it to the ship at 20 degrees

1419
00:50:28,950 --> 00:50:26,800
uh things happen um

1420
00:50:30,069 --> 00:50:28,960
gases you know your

1421
00:50:32,069 --> 00:50:30,079
uh

1422
00:50:33,910 --> 00:50:32,079
300 atmospheres at the bottom of the sea

1423
00:50:34,790 --> 00:50:33,920
floor and one atmosphere at the surface

1424
00:50:37,030 --> 00:50:34,800
and

1425
00:50:39,109 --> 00:50:37,040
if you have dissolved gases that are in

1426
00:50:41,349 --> 00:50:39,119
excessive sort of standard temperature

1427
00:50:43,910 --> 00:50:41,359
and pressure uh

1428
00:50:47,910 --> 00:50:43,920
uh capabilities then yes they will

1429
00:50:51,030 --> 00:50:47,920
um come out of solution uh so so we have

1430
00:50:55,430 --> 00:50:51,040
to be aware of our environment

1431
00:50:58,150 --> 00:50:55,440
and uh try to do our best um

1432
00:51:00,230 --> 00:50:58,160
knowing what potential caveats

1433
00:51:01,990 --> 00:51:00,240
exist

1434
00:51:03,589 --> 00:51:02,000
yeah i mean i agree the same thing for

1435
00:51:06,230 --> 00:51:03,599
arctic samples and the same thing for

1436
00:51:08,309 --> 00:51:06,240
martian samples um you know we we have

1437
00:51:11,589 --> 00:51:08,319
to think through it and do our best

1438
00:51:13,109 --> 00:51:11,599

honestly uh our next question comes from

1439
00:51:14,069 --> 00:51:13,119
another production assistant for the

1440
00:51:15,829 --> 00:51:14,079
show

1441
00:51:17,670 --> 00:51:15,839
miriam nassim

1442
00:51:19,670 --> 00:51:17,680
and miriam wants to know if you could

1443
00:51:22,549 --> 00:51:19,680
talk a bit more about the opportunities

1444
00:51:23,990 --> 00:51:22,559
that are available for graduate and phd

1445
00:51:25,990 --> 00:51:24,000
students to

1446
00:51:27,829 --> 00:51:26,000
as students conduct research on

1447
00:51:30,069 --> 00:51:27,839
scientific vessels or in ocean

1448
00:51:31,589 --> 00:51:30,079
expeditions

1449
00:51:41,030 --> 00:51:31,599
um

1450
00:51:42,790 --> 00:51:41,040
there's a thing called you knows uh i

1451
00:51:45,670 --> 00:51:42,800
can't think of the what the acronym

1452
00:51:47,589 --> 00:51:45,680
stands for but it's basically university

1453
00:51:49,670 --> 00:51:47,599
something for oceanography

1454
00:51:52,309 --> 00:51:49,680
i don't know but basically it's a

1455
00:51:55,030 --> 00:51:52,319
consortium of ships that are run by

1456
00:51:56,069 --> 00:51:55,040
uh different universities and those

1457
00:51:58,470 --> 00:51:56,079
ships are

1458
00:52:02,309 --> 00:51:58,480
to conduct oceanographic research

1459
00:52:03,430 --> 00:52:02,319
um oftentimes those ships will have uh

1460
00:52:05,109 --> 00:52:03,440
pis

1461
00:52:07,670 --> 00:52:05,119
from different universities

1462
00:52:08,710 --> 00:52:07,680
um using those ships and they will need

1463
00:52:11,270 --> 00:52:08,720

people

1464
00:52:14,390 --> 00:52:11,280
to go out and conduct research

1465
00:52:16,630 --> 00:52:14,400
there's also other programs like uh

1466
00:52:17,589 --> 00:52:16,640
woods hole oceanographic runs a program

1467
00:52:20,069 --> 00:52:17,599
for

1468
00:52:22,230 --> 00:52:20,079
getting people involved with alvin which

1469
00:52:24,549 --> 00:52:22,240
is the submersible

1470
00:52:26,710 --> 00:52:24,559
and i think they've also had one maybe

1471
00:52:30,829 --> 00:52:26,720
for jason in the past i'm not sure which

1472
00:52:33,670 --> 00:52:30,839
is the rov and the idea there is getting

1473
00:52:36,390 --> 00:52:33,680
um great later stage graduate students

1474
00:52:38,870 --> 00:52:36,400
and post docs out on the vessels to see

1475
00:52:40,390 --> 00:52:38,880
how those vessels work and operate and

1476
00:52:42,549 --> 00:52:40,400
what they can provide

1477
00:52:45,190 --> 00:52:42,559
um how are they different than

1478
00:52:46,470 --> 00:52:45,200
uh just coring and uh

1479
00:52:48,870 --> 00:52:46,480
or collecting

1480
00:52:51,670 --> 00:52:48,880
uh water using hydrocaster or something

1481
00:52:54,309 --> 00:52:51,680
along those lines so uh there are

1482
00:52:56,630 --> 00:52:54,319
distinct programs um

1483
00:52:58,470 --> 00:52:56,640
i don't know i i can't really other than

1484
00:53:00,549 --> 00:52:58,480
the woods hole one i can't point you

1485
00:53:01,990 --> 00:53:00,559
directly to one

1486
00:53:03,589 --> 00:53:02,000
um

1487
00:53:06,950 --> 00:53:03,599
and uh there are

1488
00:53:08,549 --> 00:53:06,960

the unals page will certainly have pis

1489
00:53:10,470 --> 00:53:08,559
and their university

1490
00:53:13,190 --> 00:53:10,480
uh principal investigators and the

1491
00:53:14,549 --> 00:53:13,200
universities of who's um taking the

1492
00:53:16,230 --> 00:53:14,559
ships out

1493
00:53:17,109 --> 00:53:16,240
um and then you could contact those

1494
00:53:19,109 --> 00:53:17,119
people

1495
00:53:21,030 --> 00:53:19,119
to see what um what they're doing and if

1496
00:53:23,190 --> 00:53:21,040
they need help or people and so on and

1497
00:53:25,349 --> 00:53:23,200
so forth

1498
00:53:26,870 --> 00:53:25,359
thank you so much for sharing that and i

1499
00:53:28,950 --> 00:53:26,880
just realized we've actually come to the

1500
00:53:31,750 --> 00:53:28,960
top of the hour and the end of our show

1501
00:53:33,349 --> 00:53:31,760
unfortunately uh dr wheat it has been a

1502
00:53:35,349 --> 00:53:33,359
humongous pleasure having you on the

1503
00:53:37,190 --> 00:53:35,359
show thank you so much for joining us

1504
00:53:38,790 --> 00:53:37,200
uh thank you for having me

1505
00:53:41,589 --> 00:53:38,800
yeah and i look forward to hearing more

1506
00:53:44,069 --> 00:53:41,599
about your research in mud volcanoes and

1507
00:53:45,750 --> 00:53:44,079
other places on the sea floor and i hope

1508
00:53:47,990 --> 00:53:45,760
that you get a humongous grant to help

1509
00:53:49,589 --> 00:53:48,000
fund the research that you want to do

1510
00:53:51,589 --> 00:53:49,599
and to hear far more about some of these

1511
00:53:53,910 --> 00:53:51,599
incredible things we're learning as we

1512
00:53:56,630 --> 00:53:53,920
continue to explore that rather

1513
00:53:57,910 --> 00:53:56,640

unexplored region of our own world in

1514
00:53:59,270 --> 00:53:57,920
the deep sea

1515
00:54:01,430 --> 00:53:59,280
for those watching if you'd like to

1516
00:54:03,430 --> 00:54:01,440
learn a bit more about dr reed's work

1517
00:54:08,230 --> 00:54:03,440
you can check out his labs website at

1518
00:54:12,470 --> 00:54:11,030
sub seafloor hyphen lab

1519
00:54:13,750 --> 00:54:12,480
dr wheat is there anything else you'd

1520
00:54:15,349 --> 00:54:13,760
like to share with our audience before

1521
00:54:17,670 --> 00:54:15,359
we sign off

1522
00:54:19,190 --> 00:54:17,680
um i would just say if you're interested

1523
00:54:20,230 --> 00:54:19,200
in working in the deep sea and the

1524
00:54:22,829 --> 00:54:20,240
seafloor

1525
00:54:27,109 --> 00:54:22,839
the main thing is perseverance

1526
00:54:28,950 --> 00:54:27,119
um perseverance counts a lot

1527
00:54:30,790 --> 00:54:28,960
i love it yeah perseverance counts for

1528
00:54:32,470 --> 00:54:30,800
everything um so for those who want to

1529
00:54:34,870 --> 00:54:32,480
stay in the loop on upcoming episodes of

1530
00:54:36,710 --> 00:54:34,880
the show as well as more info about

1531
00:54:38,230 --> 00:54:36,720
opportunities and events from nasa

1532
00:54:40,150 --> 00:54:38,240
astrobiology

1533
00:54:41,990 --> 00:54:40,160
mike toyon our director producer is

1534
00:54:44,150 --> 00:54:42,000
putting a link on the screen right now

1535
00:54:47,510 --> 00:54:44,160
so you can sign up for the official

1536
00:54:49,270 --> 00:54:47,520
mailing list from nasa astrobiology uh i

1537
00:54:50,950 --> 00:54:49,280
hope that all of you will stay tuned

1538
00:54:54,870 --> 00:54:50,960

just for a little bit after the credits

1539
00:54:57,750 --> 00:54:54,880
roll here for a sneak peek at episode 2

1540
00:54:59,670 --> 00:54:57,760
of astrobiology in the field

1541
00:55:02,390 --> 00:54:59,680
this time astrobiology in the field

1542
00:55:04,870 --> 00:55:02,400
takes you to greenland to study not only

1543
00:55:06,630 --> 00:55:04,880
some of the oldest rocks on the earth

1544
00:55:08,870 --> 00:55:06,640
but some questions about what

1545
00:55:10,230 --> 00:55:08,880
potentially could be some of the oldest

1546
00:55:12,789 --> 00:55:10,240
signs of life

1547
00:55:14,950 --> 00:55:12,799
on the earth so thank you dr wheat for

1548
00:55:17,190 --> 00:55:14,960
joining us thank you to our audience for

1549
00:55:22,220 --> 00:55:17,200
joining us uh and until next time

1550
00:55:22,230 --> 00:55:37,589
[Music]