## Modern Analog: Shark Bay

## Outcrop: Dresser Formation

1
00:00:06,789 --> 00:00:03,590
hi everyone

2
00:00:09,190 --> 00:00:06,799
my name is michaela and i am a phd

3
00:00:09,990 --> 00:00:09,200
student from te farewell nanga o tamaki

4
00:00:13,030 --> 00:00:10,000
makuro

5
00:00:14,150 --> 00:00:13,040
the university of auckland and today i'm

6
00:00:15,829 --> 00:00:14,160
just going to talk to you

7
00:00:17,349 --> 00:00:15,839
about some of the work i've been doing

8
00:00:19,750 --> 00:00:17,359
for my phd

9
00:00:22,310 --> 00:00:19,760
which focuses on recently obtained drill

10
00:00:24,150 --> 00:00:22,320
core from the 3.48 billion year old

11
00:00:26,390 --> 00:00:24,160
dresser formation

12
00:00:28,310 --> 00:00:26,400
but just quickly before i begin i'd like

13
00:00:29,349 --> 00:00:28,320

to take this moment to acknowledge the

14
00:00:31,269 --> 00:00:29,359
number people

15
00:00:33,030 --> 00:00:31,279
as the traditional custodians of the

16
00:00:36,389 --> 00:00:33,040
land and what you may feel work took

17
00:00:39,590 --> 00:00:36,399
a place and also extend any respect to

18
00:00:41,510 --> 00:00:39,600
all first nations people prison

19
00:00:43,990 --> 00:00:41,520
so a quick background of the dresser

20
00:00:46,869 --> 00:00:44,000
formation for those who might not know

21
00:00:47,670 --> 00:00:46,879
it's a geologic unit that's 3.48 billion

22
00:00:49,830 --> 00:00:47,680
years old

23
00:00:51,750 --> 00:00:49,840
and is located in the pelba craton in

24
00:00:54,069 --> 00:00:51,760
northwestern australia

25
00:00:55,110 --> 00:00:54,079
the paleo environmental setting for the

26
00:00:58,389 --> 00:00:55,120
deposit is an

27
00:01:00,549 --> 00:00:58,399
ancient dynamic hydrothermal

28
00:01:02,790 --> 00:01:00,559
volcanic caldera setting and this

29
00:01:05,590 --> 00:01:02,800
caldera setting would have undertaken

30
00:01:07,190 --> 00:01:05,600
periods of inflation and deflation as

31
00:01:09,190 --> 00:01:07,200
well as having a lot of hydrothermal

32
00:01:11,030 --> 00:01:09,200
fluid circulating around

33
00:01:12,390 --> 00:01:11,040
but what's really interesting about the

34
00:01:14,630 --> 00:01:12,400
dress information

35
00:01:15,830 --> 00:01:14,640
is that it provides earth's most

36
00:01:18,310 --> 00:01:15,840
convincing

37
00:01:19,109 --> 00:01:18,320
evidence of early life in the geologic

38
00:01:21,590 --> 00:01:19,119

record

39
00:01:23,190 --> 00:01:21,600
and this is through a diverse array of

40
00:01:25,670 --> 00:01:23,200
biosignatures

41
00:01:28,230 --> 00:01:25,680
and one of these bio signatures are

42
00:01:30,230 --> 00:01:28,240
stromelites

43
00:01:31,590 --> 00:01:30,240
so from stromatolites for those who

44
00:01:34,630 --> 00:01:31,600
might not know

45
00:01:35,590 --> 00:01:34,640
are interlayed microbial and sedimentary

46
00:01:37,749 --> 00:01:35,600
structures

47
00:01:38,789 --> 00:01:37,759
and these just build up over time on top

48
00:01:40,550 --> 00:01:38,799
of each other

49
00:01:42,870 --> 00:01:40,560
and so the top picture we have an

50
00:01:45,030 --> 00:01:42,880
example of a modern analog so

51
00:01:46,389 --> 00:01:45,040
one that's currently alive and this is

52
00:01:49,350 --> 00:01:46,399
in shark bay which is

53
00:01:51,109 --> 00:01:49,360
also in western australia maybe not the

54
00:01:53,270 --> 00:01:51,119
prettiest form of life but

55
00:01:54,630 --> 00:01:53,280
it has survived more than 3.5 billion

56
00:01:57,990 --> 00:01:54,640
years

57
00:02:01,109 --> 00:01:58,000
and then on the bottom image you can see

58
00:02:02,630 --> 00:02:01,119
a outcrop image of stromatolite from the

59
00:02:04,550 --> 00:02:02,640
dresser formation

60
00:02:05,990 --> 00:02:04,560
so if you look at where those white

61
00:02:07,510 --> 00:02:06,000
squiggly lines are those are the

62
00:02:09,190 --> 00:02:07,520
microbial mats

63
00:02:10,630 --> 00:02:09,200

so essentially what you're looking at

64
00:02:14,390 --> 00:02:10,640
there is your great

65
00:02:17,990 --> 00:02:14,400
great great times a million grandparent

66
00:02:19,910 --> 00:02:18,000
so can you guys see the wrinkles

67
00:02:22,150 --> 00:02:19,920
so the stromatolites of the dressing

68
00:02:22,630 --> 00:02:22,160
formation are found in a range of

69
00:02:25,270 --> 00:02:22,640
different

70
00:02:26,470 --> 00:02:25,280
paleo environmental settings this is

71
00:02:29,990 --> 00:02:26,480
ranging from

72
00:02:33,509 --> 00:02:30,000
shallow lagoon all the way to hot spring

73
00:02:36,150 --> 00:02:33,519
deposits so this is a work done by dr

74
00:02:38,470 --> 00:02:36,160
tara jockage for her phd

75
00:02:39,750 --> 00:02:38,480
and what she did is she actually went

76
00:02:41,910 --> 00:02:39,760
out and she

77
00:02:43,350 --> 00:02:41,920
mapped a bunch of these stromatolites

78
00:02:45,589 --> 00:02:43,360
and discovered

79
00:02:47,030 --> 00:02:45,599
hot spring stromatolites and this is an

80
00:02:50,190 --> 00:02:47,040
example so if you look at the

81
00:02:52,070 --> 00:02:50,200
boxes d b and c you can see the

82
00:02:53,990 --> 00:02:52,080
microstramatolites in this

83
00:02:55,190 --> 00:02:54,000
and what's really exciting about this

84
00:02:58,070 --> 00:02:55,200
discovery

85
00:02:58,550 --> 00:02:58,080
is that this is the earliest evidence of

86
00:03:01,990 --> 00:02:58,560
life

87
00:03:05,350 --> 00:03:02,000
on land so this is an amazing discovery

88
00:03:07,110 --> 00:03:05,360

that tara did for her phd

89
00:03:08,390 --> 00:03:07,120
i'm just going to take a step back now

90
00:03:10,229 --> 00:03:08,400
and explain why

91
00:03:12,309 --> 00:03:10,239
hot springs are so important when it

92
00:03:13,509 --> 00:03:12,319
comes to looking for life in extreme

93
00:03:15,430 --> 00:03:13,519
environments

94
00:03:17,509 --> 00:03:15,440
and how this can relate to origin of

95
00:03:17,990 --> 00:03:17,519
life studies and early life as well as

96
00:03:20,710 --> 00:03:18,000
possible

97
00:03:24,390 --> 00:03:20,720
life on other planets so for those who

98
00:03:26,630 --> 00:03:24,400
might not know how hot springs form

99
00:03:28,149 --> 00:03:26,640
so what happens is you get meteoric

100
00:03:31,030 --> 00:03:28,159
water so rain water

101
00:03:32,390 --> 00:03:31,040
and this percolates down through porous

102
00:03:34,630 --> 00:03:32,400
cracks and fishes

103
00:03:35,750 --> 00:03:34,640
in the underlying rock and as it

104
00:03:37,670 --> 00:03:35,760
percolates down

105
00:03:40,149 --> 00:03:37,680
it eventually comes close to an

106
00:03:42,869 --> 00:03:40,159
underlying magmatic source

107
00:03:43,830 --> 00:03:42,879
and this magmatic source gives off a

108
00:03:46,470 --> 00:03:43,840
bunch of heat

109
00:03:47,030 --> 00:03:46,480
which causes convection and therefore

110
00:03:50,869 --> 00:03:47,040
the

111
00:03:53,110 --> 00:03:50,879
hot water begins to rise and as it rises

112
00:03:55,190 --> 00:03:53,120
it actually leeches minerals from the

113
00:03:57,509 --> 00:03:55,200

surrounding rock

114
00:03:59,270 --> 00:03:57,519
and this is a wide range of minerals and

115
00:04:02,309 --> 00:03:59,280
so if you imagine you had

116
00:04:03,830 --> 00:04:02,319
a cup of boiling hot water and you added

117
00:04:05,110 --> 00:04:03,840
a teaspoon of salt into there and you

118
00:04:07,990 --> 00:04:05,120
stirred it around

119
00:04:09,990 --> 00:04:08,000
that salt is going to dissolve but if

120
00:04:12,390 --> 00:04:10,000
you let that hot water cool down

121
00:04:13,429 --> 00:04:12,400
eventually that salt will re-precipitate

122
00:04:16,069 --> 00:04:13,439
out

123
00:04:18,469 --> 00:04:16,079
of the hot water and it's a similar

124
00:04:20,550 --> 00:04:18,479
component when you look at hot springs

125
00:04:22,310 --> 00:04:20,560
the hot water is leeching all of these

126
00:04:25,909 --> 00:04:22,320
minerals from the surrounding rock

127
00:04:28,469 --> 00:04:25,919
but eventually it will outflow

128
00:04:29,030 --> 00:04:28,479
and here we have a picture of some phd

129
00:04:31,350 --> 00:04:29,040
students

130
00:04:32,390 --> 00:04:31,360
in yellowstone taking some very

131
00:04:35,189 --> 00:04:32,400
important

132
00:04:37,510 --> 00:04:35,199
notes on geysering and geyser formation

133
00:04:39,350 --> 00:04:37,520
but yes the hot water will outflow and

134
00:04:42,710 --> 00:04:39,360
eventually it will cool down

135
00:04:46,230 --> 00:04:42,720
and so what you get is these

136
00:04:48,790 --> 00:04:46,240
vast planes of hot spring deposits

137
00:04:50,230 --> 00:04:48,800
which are undertaking a bunch of

138
00:04:52,070 --> 00:04:50,240

different temperatures

139
00:04:53,270 --> 00:04:52,080
they have a bunch of different phs and

140
00:04:54,310 --> 00:04:53,280
they have a bunch of different water

141
00:04:56,870 --> 00:04:54,320
chemistry

142
00:04:58,070 --> 00:04:56,880
based on the minerals that were leached

143
00:05:00,950 --> 00:04:58,080
the distance from

144
00:05:01,510 --> 00:05:00,960
where they outflowed from the vent and

145
00:05:05,909 --> 00:05:01,520
the

146
00:05:07,670 --> 00:05:05,919
chemistries

147
00:05:09,830 --> 00:05:07,680
and so if you look at these stunning

148
00:05:12,950 --> 00:05:09,840
pictures from yellowstone

149
00:05:16,150 --> 00:05:12,960
everywhere you see those vibrant

150
00:05:19,189 --> 00:05:16,160
pink orange yellow green

151
00:05:21,590 --> 00:05:19,199
brown colors those are all

152
00:05:22,950 --> 00:05:21,600
microbial mattes so what's super

153
00:05:25,909 --> 00:05:22,960
important about hot spring

154
00:05:27,670 --> 00:05:25,919
deposits is that life is everywhere in

155
00:05:29,670 --> 00:05:27,680
these systems

156
00:05:32,070 --> 00:05:29,680
life is thriving in all different

157
00:05:34,070 --> 00:05:32,080
temperatures all different ph's

158
00:05:36,550 --> 00:05:34,080
and all different water chemistries so

159
00:05:39,590 --> 00:05:36,560
these are extreme environments

160
00:05:41,189 --> 00:05:39,600
that are teeming with life and what is

161
00:05:43,749 --> 00:05:41,199
also really interesting about

162
00:05:45,029 --> 00:05:43,759
these pictures is everywhere you see

163
00:05:47,670 --> 00:05:45,039

that white

164
00:05:48,550 --> 00:05:47,680
kind of gray color that's actually a

165
00:05:51,510 --> 00:05:48,560
mineral called

166
00:05:53,350 --> 00:05:51,520
silica and so as i said before the

167
00:05:54,870 --> 00:05:53,360
minerals get incorporated into the hot

168
00:05:57,270 --> 00:05:54,880
water because they dissolve

169
00:05:59,270 --> 00:05:57,280
but eventually as this hot water cools

170
00:06:01,909 --> 00:05:59,280
down and eventually dries out

171
00:06:02,950 --> 00:06:01,919
minerals re-precipitate out and one of

172
00:06:05,990 --> 00:06:02,960
these minerals

173
00:06:08,629 --> 00:06:06,000
is silica and so what's really important

174
00:06:10,230 --> 00:06:08,639
about silica is that it rapidly entombs

175
00:06:12,790 --> 00:06:10,240
these microbial mats

176
00:06:14,550 --> 00:06:12,800
so what you're looking at right there is

177
00:06:16,469 --> 00:06:14,560
active fossilization

178
00:06:18,230 --> 00:06:16,479
so you are essentially looking at rock

179
00:06:20,150 --> 00:06:18,240
being formed

180
00:06:21,350 --> 00:06:20,160
and this is what's happening with the

181
00:06:23,189 --> 00:06:21,360
early life studies

182
00:06:25,189 --> 00:06:23,199
we have rapid internment of these

183
00:06:27,029 --> 00:06:25,199
microbes

184
00:06:28,629 --> 00:06:27,039
and so we have been able to go through

185
00:06:31,189 --> 00:06:28,639
and we've been able to map

186
00:06:32,950 --> 00:06:31,199
the type of hot spring faces the type of

187
00:06:33,590 --> 00:06:32,960
deposits and textures you'd expect to

188
00:06:36,390 --> 00:06:33,600

see

189
00:06:38,070 --> 00:06:36,400
based on distance from the vent from

190
00:06:39,990 --> 00:06:38,080
where the hot water comes out

191
00:06:41,909 --> 00:06:40,000
this gives you an indication of where

192
00:06:43,990 --> 00:06:41,919
you are in the system based on distance

193
00:06:46,710 --> 00:06:44,000
from the vent and temperature

194
00:06:48,710 --> 00:06:46,720
and this is what tara did for her phd

195
00:06:49,589 --> 00:06:48,720
she went out and she mapped a bunch of

196
00:06:51,909 --> 00:06:49,599
these different

197
00:06:52,870 --> 00:06:51,919
hot spring deposits in the dresser

198
00:06:55,029 --> 00:06:52,880
including

199
00:06:57,510 --> 00:06:55,039
this one which i showed before which is

200
00:06:59,670 --> 00:06:57,520
actually geyserite so that's

201
00:07:00,950 --> 00:06:59,680
right at that vent so these would have

202
00:07:04,629 --> 00:07:00,960
been extreme

203
00:07:06,710 --> 00:07:04,639
thermophilic so heat loving microbes

204
00:07:09,029 --> 00:07:06,720
it's an absolutely stunning phd and

205
00:07:12,710 --> 00:07:09,039
amazing work from tara

206
00:07:13,430 --> 00:07:12,720
the only issue with these deposits is

207
00:07:15,990 --> 00:07:13,440
that they're from

208
00:07:16,710 --> 00:07:16,000
outcrops and these outcrops are

209
00:07:19,510 --> 00:07:16,720
weathered to

210
00:07:21,830 --> 00:07:19,520
70 meters depth so because of this a

211
00:07:23,430 --> 00:07:21,840
drilling project was proposed based off

212
00:07:25,510 --> 00:07:23,440
the work that tara did

213
00:07:26,469 --> 00:07:25,520

to try and intersect these hot springs

214
00:07:29,350 --> 00:07:26,479
at depth

215
00:07:30,309 --> 00:07:29,360
and this is what my phd focuses on so

216
00:07:33,110 --> 00:07:30,319
here are some

217
00:07:33,749 --> 00:07:33,120
stunning images of us out collecting our

218
00:07:36,469 --> 00:07:33,759
drill core

219
00:07:37,749 --> 00:07:36,479
and the nice and toasty 40 degree

220
00:07:40,070 --> 00:07:37,759
celsius

221
00:07:40,790 --> 00:07:40,080
uh outback heat you can see us also

222
00:07:43,350 --> 00:07:40,800
trying to

223
00:07:44,390 --> 00:07:43,360
fight away the flies while we were

224
00:07:47,589 --> 00:07:44,400
eating

225
00:07:49,670 --> 00:07:47,599
and so we obtained uh four drill cores

226
00:07:51,990 --> 00:07:49,680
of five to thirty meters in length

227
00:07:53,189 --> 00:07:52,000
and what we found is that these drill

228
00:07:56,230 --> 00:07:53,199
cores show

229
00:07:58,869 --> 00:07:56,240
excellent preservation of uh

230
00:07:59,670 --> 00:07:58,879
bio signatures of textual biosignatures

231
00:08:02,390 --> 00:07:59,680
so here is an

232
00:08:03,830 --> 00:08:02,400
outcrop image of stromatolites and if

233
00:08:05,029 --> 00:08:03,840
you follow my

234
00:08:07,110 --> 00:08:05,039
mouse you can see where the

235
00:08:09,189 --> 00:08:07,120
stromatolites are and so

236
00:08:10,790 --> 00:08:09,199
there's been a lot of discussion in the

237
00:08:13,749 --> 00:08:10,800
scientific literature

238
00:08:15,029 --> 00:08:13,759

over the authentication of these

239
00:08:17,189 --> 00:08:15,039
biosignatures

240
00:08:18,309 --> 00:08:17,199
but if you look at the core deposits you

241
00:08:20,390 --> 00:08:18,319
can actually see

242
00:08:21,830 --> 00:08:20,400
how well preserved these textual

243
00:08:23,589 --> 00:08:21,840
biosignatures are

244
00:08:26,230 --> 00:08:23,599
these are absolutely stunning

245
00:08:28,710 --> 00:08:26,240
preservation of stromatolites

246
00:08:31,110 --> 00:08:28,720
and not only that but we actually have

247
00:08:33,990 --> 00:08:31,120
potential primary minerals of

248
00:08:35,829 --> 00:08:34,000
pyrite being preserved as well so we're

249
00:08:36,790 --> 00:08:35,839
very excited about the preservation in

250
00:08:39,029 --> 00:08:36,800
this core

251
00:08:40,070 --> 00:08:39,039
and particularly this horizon is of

252
00:08:41,670 --> 00:08:40,080
interest because

253
00:08:44,389 --> 00:08:41,680
you can see the stromatolites have been

254
00:08:47,110 --> 00:08:44,399
preserved because of an event horizon

255
00:08:48,470 --> 00:08:47,120
so there was some carbonate sands

256
00:08:49,670 --> 00:08:48,480
sandstone on top

257
00:08:52,310 --> 00:08:49,680
and so we thought it would be

258
00:08:54,630 --> 00:08:52,320
interesting to image into this

259
00:08:55,350 --> 00:08:54,640
into the core to see the 3d morphology

260
00:08:59,030 --> 00:08:55,360
of these

261
00:09:01,430 --> 00:08:59,040
deposits so we went over to ansto

262
00:09:02,790 --> 00:09:01,440
which is over in australia and we use

263
00:09:05,190 --> 00:09:02,800

the dingo

264
00:09:06,470 --> 00:09:05,200
and australians love giving animal names

265
00:09:09,350 --> 00:09:06,480
to high-powered

266
00:09:11,509 --> 00:09:09,360
machines and this image through the core

267
00:09:13,910 --> 00:09:11,519
and if you look at this middle horizon

268
00:09:15,110 --> 00:09:13,920
you can see the stromatolites popping in

269
00:09:18,030 --> 00:09:15,120
and out

270
00:09:19,590 --> 00:09:18,040
and this actually helps us with this uh

271
00:09:21,030 --> 00:09:19,600
biogenicity

272
00:09:23,030 --> 00:09:21,040
because it shows that these

273
00:09:25,190 --> 00:09:23,040
stromatolites are

274
00:09:26,630 --> 00:09:25,200
3d and morphology so that's very

275
00:09:27,670 --> 00:09:26,640
exciting and it's something i'm working

276
00:09:29,910 --> 00:09:27,680
on at the moment

277
00:09:31,110 --> 00:09:29,920
another interesting discovery that we've

278
00:09:34,389 --> 00:09:31,120
made in the court

279
00:09:36,470 --> 00:09:34,399
is that if you look at the core or

280
00:09:38,389 --> 00:09:36,480
correlate the cores between each other

281
00:09:40,389 --> 00:09:38,399
you find that there's

282
00:09:41,509 --> 00:09:40,399
not a lot of areas where correlation can

283
00:09:43,190 --> 00:09:41,519
occur

284
00:09:45,829 --> 00:09:43,200
however when you take a step back and

285
00:09:48,389 --> 00:09:45,839
you try and correlate with outcrops

286
00:09:50,870 --> 00:09:48,399
that are kilometers away we start to see

287
00:09:53,350 --> 00:09:50,880
repetitions of specific horizons

288
00:09:55,190 --> 00:09:53,360

and one of these horizons is this green

289
00:09:57,110 --> 00:09:55,200
swirly horizon you can see in these

290
00:09:58,790 --> 00:09:57,120
stratigraphy logs

291
00:10:01,430 --> 00:09:58,800
and here's a picture of the green swirly

292
00:10:02,870 --> 00:10:01,440
horizon outcrop and then in core

293
00:10:04,710 --> 00:10:02,880
and when we start to think of

294
00:10:08,550 --> 00:10:04,720
environments that show the

295
00:10:09,430 --> 00:10:08,560
similar repetition geothermal systems

296
00:10:12,069 --> 00:10:09,440
are one of these

297
00:10:13,110 --> 00:10:12,079
where you don't have a lot of

298
00:10:15,110 --> 00:10:13,120
correlation

299
00:10:16,870 --> 00:10:15,120
in the small scale but when you take a

300
00:10:19,190 --> 00:10:16,880
regional scale there is a lot of

301
00:10:20,710 --> 00:10:19,200
reoccurring lithologies

302
00:10:22,550 --> 00:10:20,720
so we're actually quite excited because

303
00:10:25,030 --> 00:10:22,560
we think this could potentially be some

304
00:10:28,310 --> 00:10:25,040
more hot spring deposits

305
00:10:31,110 --> 00:10:28,320
we also think we've discovered some

306
00:10:32,069 --> 00:10:31,120
palisade texture so palisade texture

307
00:10:35,350 --> 00:10:32,079
forms on

308
00:10:38,230 --> 00:10:35,360
the distal apron of a hot spring

309
00:10:38,790 --> 00:10:38,240
and what's really interesting is that if

310
00:10:41,350 --> 00:10:38,800
this is

311
00:10:43,670 --> 00:10:41,360
palisade texture then this would be the

312
00:10:45,590 --> 00:10:43,680
earliest evidence of micro

313
00:10:47,350 --> 00:10:45,600

microbial filaments in the geologic

314
00:10:50,470 --> 00:10:47,360
record so that's what i'm currently

315
00:10:52,870 --> 00:10:50,480
investigating at the moment as well

316
00:10:55,190 --> 00:10:52,880
and then finally we've identified

317
00:10:57,910 --> 00:10:55,200
several horizons with spherial

318
00:11:00,310 --> 00:10:57,920
deposits and these spherical deposits

319
00:11:01,509 --> 00:11:00,320
have textures that are similar to impact

320
00:11:03,750 --> 00:11:01,519
sphericals

321
00:11:04,790 --> 00:11:03,760
so the earlier ikea would have been a

322
00:11:07,430 --> 00:11:04,800
really hostile

323
00:11:08,389 --> 00:11:07,440
place to live there would have been no

324
00:11:10,310 --> 00:11:08,399
atmosphere

325
00:11:12,870 --> 00:11:10,320
and what is also predicted is that there

326
00:11:14,949 --> 00:11:12,880
would have been constant bombardment

327
00:11:16,069 --> 00:11:14,959
from these large impactors the scale

328
00:11:19,110 --> 00:11:16,079
that would have killed

329
00:11:21,269 --> 00:11:19,120
dinosaurs but unfortunately the geologic

330
00:11:21,990 --> 00:11:21,279
record is quite sparse with indications

331
00:11:23,910 --> 00:11:22,000
of this

332
00:11:26,069 --> 00:11:23,920
so this is really exciting because this

333
00:11:29,110 --> 00:11:26,079
helps try and fill that gap

334
00:11:30,870 --> 00:11:29,120
but also if these are impacts rules then

335
00:11:33,509 --> 00:11:30,880
they would also be the oldest in the

336
00:11:35,910 --> 00:11:33,519
geologic record which is quite exciting

337
00:11:37,829 --> 00:11:35,920
so that's just a quick brief results of

338
00:11:39,430 --> 00:11:37,839

what i've been finding in my

339
00:11:41,430 --> 00:11:39,440
course and i just want to say big thank

340
00:11:42,389 --> 00:11:41,440
you for listening and big thank you to

341
00:11:44,790 --> 00:11:42,399
our sponsors

342
00:11:46,710 --> 00:11:44,800
and also here is what people in the

343
00:11:49,190 --> 00:11:46,720
outback consider to be